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Bulletin of the British Museum (Natural History)

Seaweeds of the western coast of tropical Africa and adjacent islands: a critical assessment
IV. Rhodophyta (Florideae)
1. Genera A-F

James H. Price, David M. John &
George W. Lawson

Botany series Vol 15 No 1 30 October 1986

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Seaweeds of the western coast of tropical Africa and adjacent islands: a critical assessment.
IV. Rhodophyta (Florideae) 1. Genera A–F

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Synopsis

This paper assembles and, so far as is possible without extended field and herbarium studies, examines critically the validity of records of marine and brackish-water Rhodophyta (Florideae) for the western coast of tropical Africa. The whole mainland coastline from the northern boundary of Western Sahara southwards to the southern boundary of Namibia (South West Africa), the oceanic islands from the Salvage Islands southwards to Ascension and St Helena, and all islands close to the African mainland coast are included in the area covered. Each species entry includes all traced records for the species, the names which have previously been applied to it for the area, and additional comments or evaluation, as necessary. Comments are also provided at generic level in difficult or very complex cases. Fourteen new combinations are made: *Antithamnionella elegans* (Berthold) J. Price & D. John, *Audouinella byssacea* (Kützing) J. Price, *A. cymopoliae* (Børgesen) J. Price, *A. macropoda* (P. Dangeard) J. Price, *A. naumannii* (Askenasy) J. Price, *A. polyblasta* (Rosenvinge) J. Price, *A. streblocladiae* (P. Dangeard) J. Price, *Ceramium compactum* (Bory) J. Price, *Meristotheca schrammii* (P. & H. Crouan ex Schramm & Mazé) J. Price, D. John & G. W. Lawson, *Nothogenia magnifica* (Pilger) J. Price, *Titanoderma confinis* (P. & H. Crouan) J. Price, D. John & G. W. Lawson, *T. geometricum* (Lemoine in Børgesen) J. Price, D. John & G. W. Lawson, *T. hapalidioides* (P. & H. Crouan) J. Price, D. John & G. W. Lawson, and *T. papillosum* (Zanardini ex Hauck) J. Price, D. John & G. W. Lawson.

Introduction

The area dealt with in this part of the work is identical with that covered in previously published parts (Lawson & Price, 1969; Price, John & Lawson, 1978; John, Price, Maggs & Lawson, 1979). Such country name changes as have occurred since the earlier publications are incorporated in the legend for the coastline map of west Africa (Fig. 1). Both genera and constituent species are again here listed in alphabetical order. It was originally envisaged that the Rhodophyta would be divided systematically, rather than on the hitherto principally employed alphabetical basis, so that the group could be treated in several smaller separate parts; this process was therefore commenced with the Bangiophyceae (part III). It has become clear from user comment, however, that this does not provide the arrangement found most effective, so that we have

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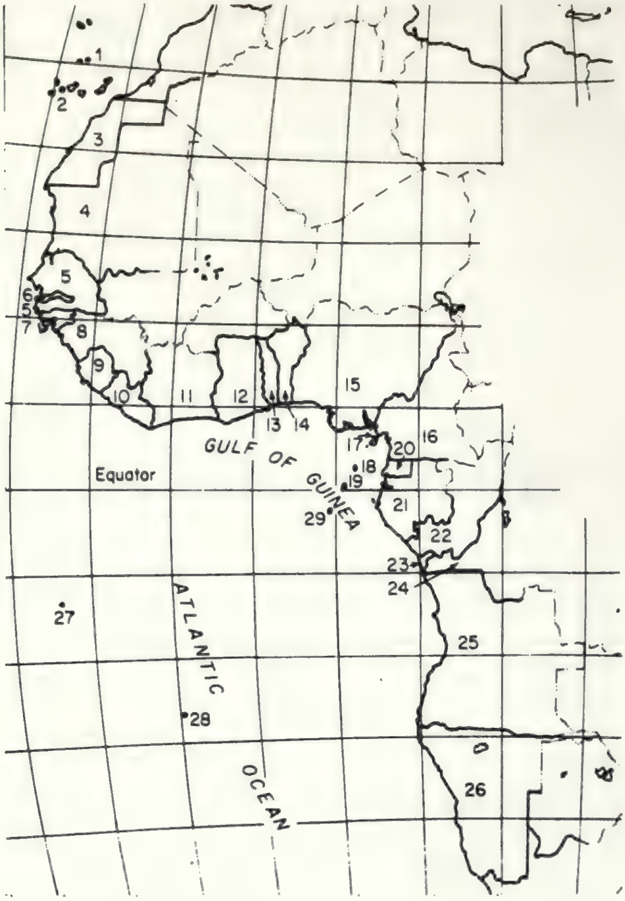

Fig. 1 The coastline of tropical west Africa and the offshore islands.
1, Salvage Islands; 2, Canary Islands; 3,* Western Sahara [= former Spanish Sahara, Spanish West Africa] (includes the often quoted Rio de Oro, the southern region of the country, but excludes Ifni); 4, Mauritanie; 5, Sénégal; 6, Gambia; 7, Guinea-Bissau [= Portuguese Guinea]; 8, Guinée; 9, Sierra Leone; 10, Liberia; 11, Côte d'Ivoire; 12, Ghana; 13, Togo; 14, Benin [= Dahomey]; 15, Nigeria; 16, Cameroun; 17, † Bioko [= Macias Nguema Biyogo, Fernando Póo]; 18, Príncipe; 19, São Tomé; 20, † Equatorial Guinea [= Spanish Guinea]; 21, Gabon; 22, ‡ Republic of the Congo; 23, Cabinda; 24, Zaire [= Congo Republic]; 25, Angola; 26, Namibia [= South West Africa]; 27, Ascension Island; 28, Saint Helena; 29, Pagalu [= Annobón]. The Cape Verde Islands, which lie immediately to the west of Dakar (Sénégal), have been omitted from this map but are included in the species list that follows.

* The former colony of Spanish Sahara no longer officially exists, the territory it once covered being divided, by agreement, between Morocco and Mauritanie. The effective date of the division, Spain concurring, was 28 February 1976, although guerrilla opposition delayed matters until a formal agreement on 14 April 1976. The attempt to maintain the territory as the Democratic Sahara [Saharan] Arab Republic has apparently entered the 'realm of myth' (Gretton, 1976). The authors' citation terminology is maintained throughout the records.

† Nos 17 (Bioko) and 20 (Spanish Guinea, = Rio Muni) on the original map (part I) are now jointly administered, with Annobón (29), as Equatorial Guinea. Bioko and Annobón are entered separately, where appropriate, in the species list.

‡ Loango, a name much used by earlier collectors such as Welwitsch, was formerly a coastal region of West Africa. Its application appears to have included much of the coastline of the Republic of the Congo (22), as well as of Cabinda (23) and Zaire (24). Because by far the longest and rockiest part of the Loango coast lies now within the Republic of the Congo we have attributed all marine algal records from Loango to the Congo.

returned to the alphabetical organisation of earlier parts. Since this has required reorganisation of data on the whole of the Florideae, larger publications and rather longer delay in appearance than originally projected have both resulted; even now, space restraints have precluded the desired single overall paper and we are regretfully producing the text in three portions, this first covering generic names with initials A to F, inclusive.

Each main entry consists of three, sometimes four, principal parts:

(i) *The major bold heading*, which represents the currently accepted name and authorities.

(ii) *Subsidiary italicised headings at intervals within the entry text.* These appear in square brackets and represent the different ways in which the species has been referred to by authors publishing records of relevance for the area. Each italicised heading essentially subdivides the overall entry for the species. The manner of citation of species names has been maintained from the source works, even when manifestly incorrect, unless the original form of the author's record required clarification for comprehension. There will thus be no doubt as to which record we attribute to which accepted species; anomalies requiring further explanation are subject to fuller treatment in intermediary or terminal notes to entries (see below).

(iii) *The distributional data*, within which the countries or island groups are arranged in alphabetical order, and more generalised but still relevant statements of distribution appear following the specific countries. The complete distribution pattern has to be assessed by scanning records established under *all* names by which the species has been known for the area. The generalised statements of distribution are included *verbatim* in entries since it is not always clear for precisely which countries within the area they establish records. The numbers given within the parentheses after each country name or generalised statement of distribution refer to the corresponding numbers in the references; this is true for all parts of a main entry, whether or not covered by a square-bracketed sub-heading. Works cited in the present list are newly numbered, so that a given number here does not (except by accident) correspond to that given to the same reference in previous parts of the publication. It should be stressed, therefore, that lists of references are not interchangeable and must be used only with the part with which they have been published; apart from differences in numbering sequence, not all references relevant for one part are also relevant for the others. When numbers within parentheses are followed individually by the letters 'p.p.' (pro parte), it may be taken that reassessment has shown the original material, data or concept to have involved heterogeneity. Citation of numbers suffixed by a capital letter has been necessary in some instances where references or data were detected after preparation of the full text was too far advanced to permit further numerical reorganisation. Some later references have taken the place of others discarded for various reasons, and therefore appear in alphabetical order of authors' names but out of numerical sequence; in such cases, a cross-referencing entry appears at the correct position in the numerical sequence.

New records, based either on recent field observations or on herbarium studies, appear with the word 'unpublished' in parentheses. An exception has been made in the cases of reference numbers 348 and 522, both of which relate to various aspects of the South West Africa [Namibia] Expedition of 1957. The number 522 indicates information kindly provided for us by Mr R. H. Simons from records he possessed. Similar data will possibly be published separately in the near future, associated with additional ecological information that is not relevant here, and may possibly include additional records not currently available. Various members of that Expedition (Isaac; Lawson; Simons) are involved in these projected publications; all known relevant records are included in the present listing. M. J. Wynne also has a publication in progress (36B) on his more recent collections from a short period along the Namibian coastlines, near Swakopmund; these data have been made available to us for inclusion pre-publication and we thank Professor Wynne for the courtesy.

(iv) *Additional notes* have proved necessary in the cases of many subsidiary sets of records within entries, and/or for many overall entries. These notes are inset below the entries or individual parts to which they specifically refer. Citation of references in the notes depends for its form on whether such references contain records (when they consist of authors' names, followed by the number of the reference in the terminal list and, where appropriate, relevant page numbers after a colon) or do not (when they consist of authors' names, date of publication of the work, and sometimes page numbers after a colon).

Species nomenclature has been revised as far as possible and the complete author citation is given for each currently accepted combination. Discarded combinations under which records for the area have previously been published are once again included as entries in the overall list, but only in the form of cross-references to the currently accepted names. This applies also *between* the separate parts of the Florideae. In the earlier systematic treatment of the Bangiophyceae (John, Price, Maggs & Lawson, 1979), it was necessary to include such cross-references in a separate terminal list. The additional problem, that would have arisen here, of cross-referencing from one family or order to another in a systematic treatment, has now been avoided in the reversion to alphabetical form of listing.

The necessarily preliminary nature of all parts of the treatments has always been emphasised in the introductions to these publications, and the present part is no exception. Further, the bulk of available data on distributions and presence within our area has increased immensely during the long-term currency of our critical assessments and it is clear that an overall publication for all groups, updating the information to achieve parity of treatment of all groups so far as biological knowledge permits, is a pressing necessity. This critical updating is in progress and will, of course, incorporate any required taxonomic revisions. The present list of Florideae includes all traced information up to March 1986; later changes will be incorporated into the combined updating, which it is hoped to submit for publication in 1987. Notification from users of any detected errors or omissions will be gratefully received.

We acknowledge with thanks assistance from many sources, including: (i) considerable help with critical aspects of the Corallinales by Dr Y. M. Butler and Mrs L. M. Irvine; (ii) help with difficult literature by Dr Gil-Rodriguez, Universidad de La Laguna, Tenerife, Islas Canarias; (iii) the provision of research facilities at the British Museum (Natural History) over the whole of the long period that has been needed for the furtherance of this critical assessment for a major part of the Atlantic coasts; (iv) finally, the editorial expertise of Mr J. R. Laundon and Dr A. Harrington, without whose critical eyes there would have resulted a less accurate text.

Species list

Acanthophora muscoides (L.) Bory
Angola (280; 352).
Ascension (26; 91; 133; 260; 420; 421; 422).
Bioko (350).
Cameroun (350).
Gabon (294; 350).
Gambia (296; 350).
São Tomé (93; 251; 265; 350; 535).
'warm Atlantic' (40).
'probably pantropical' (350).
'In oceano atlantico tropico' (318).
'does *not* extend from Gulf of Guinea into Senegal' (487).
[As *Acanthophora muscoides* L.]
Angola (143).
Ascension (143).
[As *Acanthophora muscoides* Bory]
Ascension (260).
'Warm Atlantic (Africa . . .)' (410).
[As *Acanthophora muscoides* Grev.]

São Tomé (263; 264).
'In oceano Atlantico tropico' (263; 264).
[As *Chondria muscoides* (L.) C. Ag.]
Ascension (19).
[As *Chondria muscoides* J. Ag.]
Ascension (22).

Note. Most of the records from Ascension are based directly on the original report by Osbeck (420; 421; 422) and its later confirmation by Bory (91). The matter of the distinctness of taxa represented by certain elements within some of the records from Angola is debated in the notes to *Acanthophora ramulosa* Lindenberg ex Kützing. Unless the significance of firm statements has been clear, the Angola element has generally here been treated as representing *Acanthophora ramulosa*, the Ascension element as *A. muscoides*. Several authors, including most recently Jaasund (1977), seem to have considered these conspecific; Jaasund's (1977) comment on *A. muscoides* included the phrase 'The type specimens from Angola (including *Chondria ramulosa* Lindenberg).' See the entry for *Acanthophora ramulosa* Lindenberg ex Kützing.

Acanthophora orientalis J. Agardh
See the entry for *Acanthophora spicifera* (Vahl) Børgesen

Acanthophora ramulosa Lindenberg ex Kützing
Angola (316).
'Ad oras Africae occidentalis' (323).
[As *Acanthophora ramulosa* (Lindenb. ms) Kütz., Steentoft emend.]
Angola (535).
São Tomé (535).
[As *Acanthophora ramulosa* Kützing]
São Tomé (350).
'in tropical parts of the eastern Atlantic ocean' (350).
[As *Acanthophora ramulosa* Lindenb.]
'Ad oras Africae occidentalis' (318).
[As *Acanthophora muscoides* (L.) Bory]
Angola (26; 133; 179).
São Tomé (251 p.p.; 265 p.p.).
'in calidiore oceano Atlantico ad oras Africae occidentalis prope Angolam' (133)

Note. The *Acanthophora ramulosa* element in De Toni's (133: 818) entry for *A. muscoides* has again been recognised as distinct by Steentoft (535) and others. It is to this element alone that the inclusion here of the records for Angola of *A. muscoides* from De Toni (133) and J. Agardh (26) refers, as also with the comment (see *A. muscoides* note) in Jaasund (280) regarding *Chondria ramulosa*. See Steentoft (535) on the earlier São Tomé records.

The attribution of authorities for the accepted combination is in some doubt. Kützing (1843: 437) indicated that he had derived the whole combination in *Acanthophora* from an annotation by Lindenberg on a specimen. J. Agardh (26) and De Toni (133), the latter possibly entirely on the basis of J. Agardh's statement, by contrast with Kützing, attributed the name *Chondria ramulosa* to a MS annotation by Lindenberg on a Herb. Binder specimen from Angola. If the latter is the truth of the matter and Lindenberg was consistent in his annotations, the authority is simply Kützing; if the former is correct, then Lindenberg ex Kützing must be employed. In neither case is there any suggestion that the *description* was provided by Lindenberg. We have currently accepted Kützing's rendering. All the records for Angola are based on the reports/collections by Lindenberg and Binder. Steentoft (535: 136–138) stated that: '. . . *A. ramulosa* is a new record for S. Tomé, and the species is apparently confined to the Gulf of Guinea.'; despite the statement, she repeated the earlier (1843) Kützing report for Angola.

For the other taxon involved in the 'pro parte' São Tomé records from Hariot (1908) and Henriques (1917), see the entry for *Acanthophora spicifera*.

Acanthophora spicifera (Vahl) Børgesen
Angola (500; 535).
Cameroun (336; 337; 350; 500; 535; 537).
Gabon (350).
Principé (350; 535).

São Tomé (350; 535).
Sénégal (535).
Sierra Leone (30; 295; 336; 350; 535).
'probably pantropical' (350).
'More or less pantropical' (535).
[As *Acanthophora muscoides* Grev.]
São Tomé (251 p.p.; 263; 264; 265 p.p.)
[As *Acanthophora Thierii* Lamour.]
Angola (41; 42; 535).
Cameroun (454; 535).
Gabon (250).
São Tomé (316).

Note. The 'St Thomas' record in De Toni (133) probably relates to the West Indian island. The occasional epithet rendering '*thierrii*' (535) is in error.

[As *Acanthophora Thierii* Lamarck]
Sénégal (282).
[As *Acanthophora Thierii* J. Ag.]
'für die weitere atlantische Küste Afrikas . . . ist nur das Vorkommen von *A. Thierii* J. Ag.' (179).

Note. For the other taxon involved in the 'pro parte' São Tomé records from 251 and 265, see the entry for *Acanthophora ramulosa* Lindenberg ex Kützing. The possibility exists (535) that *A. spicifera* (Vahl) Børgesen is conspecific with *A. orientalis* J. Agardh; Steentoft considered the distinctions to be doubtful.

Acanthophora thierii *auctorum*
See *Acanthophora spicifera* (Vahl) Børgesen

Acrochaetium
All taxa previously placed within this genus have been transferred to *Audouinella* (q.v.). The majority of the required recombinations have already been carried out by other authors, particularly for cosmopolitan or widespread species. Many of the West African records involved concern names not often employed elsewhere and material rarely collected, even within the region. Thus, other required recombinations do not appear in the literature and it has been necessary to effect them here; see the entries for *Audouinella*. When transfer has been effected into *Audouinella* without change of specific epithet or reduction to synonymy, no cross-referencing entry is provided; for all other cases, reference to the older names and combinations will reveal leads to the accepted placement of records and names.

Acrochaetium avrainvilleae Børgesen
See *Audouinella nemalionis* (De Notaris ex Dufour) Dixon.

Acrochaetium dufourii (Collins) Børgesen
See *Audouinella hallandica* (Kylin) Woelkerling and *Audouinella* spp.

Acrochaetium molle (Pilger) Hamel
See *Audouinella saviana* (Meneghini) Woelkerling.

Acrochaetium virgatulum (Harvey) Bornet
See *Audouinella secundata* (Lyngbye) Dixon.

Acrochaetium zosterae Papenfuss
See the notes to *Audouinella nemalionis* (De Notaris ex Dufour) Dixon.

Acrosorium acrospermum (J. Agardh) Kylin
Namibia (348; 522).

Note. The record in Lawson & Isaac (348) is merely a repeat of data from Simons (522). The taxon is well known from South Africa (Seagrief, 1984).

Acrosorium cincinnatum Wynne
Namibia (36B).

Note. Data sent by Wynne (26 February 1986) by means of a donated sterile isotype, epiphytic on *Corallina*, from five km south of Swakopmund (Wynne 7479). Another collection from three km south of Swakopmund is detailed in Wynne (36B), where all the required comparative data are presented.

Acrosorium maculatum (Kützing) Papenfuss
Angola (352).
Namibia (348; 352; 522).
Note. Well recorded from South Africa (Seagrief, 1984).

Acrosorium reptans (P. & H. Crouan) Kylin
See *Acrosorium uncinatum* (Turner) Kylin and *Cryptopleura ramosa* (Hudson) Kylin ex Newton.

Acrosorium uncinatum (Turner) Kylin
Canaries (13; 18; 108; 128A; 227; 232B; 375; 392).
Mauritanie (349).
Sénégal (55; 56; 59).
Western Sahara (349).
'Atlantique (de l'Angleterre au Rio de Oro . . .)' (33).
[As *Acrosorium uncinatum* Kylin]
Mauritanie (516).
[As *Acrosorium uncinatum* (J. Ag.) Kylin]
Canaries (71; 191; 489; 490; 517; 546).
Guinea-Bissau (529).
Mauritanie (542).
Sénégal (529; 542).
'Atlántico de Inglaterra a Canarias' (517).
'Atlantique, de l'Angleterre à la Mauritanie' (542).
'Atlantique: des côtes anglaises jusqu'au Rio de Oro' (222).
'Cosmopolite/subcosmopolite' (529).
'English coast southwards to the Canary Islands' (71).
'sur la côte sud sénégalaise et s'étend au moins jusqu'à la frontière de la Guinée portugaise' (529).
[As *Aglaophyllum laceratum* Montagne]
Canaries (44).
Note. Attributed here since based directly on Montagne (401), with varietal name probably simply omitted.
[As *Aglaophyllum laceratum* Montagne var. *uncinatum* Turner]
Canaries (401).
[As *Nitophyllum uncinatum* (Turner) J. Agardh]
Canaries (132; 441; 444; 554).
'Atlantischer Ozean von Südengland an südwärts bis zum Kap der Guten Hoffnung' (499).
[As *Nitophyllum uncinatum* J. Agardh]
Canaries (89; 547).
Note. See also *Acrosorium venulosum* (Zanardini) Kylin. Most authorities have concluded that, although *Acrosorium reptans* (P. & H. Crouan) Kylin is correctly regarded as only a form of reaction by *Cryptopleura ramosa* to the need for a prostrate growth-form under conditions of life on very exposed, wave-washed shores, the situation is highly complex because of the extent to which *A. reptans* and the legitimate *A. uncinatum* have both suffered mis-application as names, creating confusion in both routine determination and taxonomic practice.

Acrosorium venulosum (Zanardini) Kylin
Canaries (557).
Note. There has been suggestion (De Toni, 132: 645) that, following Batters's earlier comments, this species and *Nitophyllum thysanorhizans* Holmes could be conspecific; current placement in two different genera (*Radicilingua*; *Acrosorium*) does not support these earlier suggestions. Comments by Weisscher et al. (557), as reproduced in data provided in advance (Prud'homme van Reine, in litt. to JHP), included for

this taxon the remark 'stage of *A. uncinatum*?'. See the entry for the latter. Boudouresque et al. (1984: 47) commented that all intermediates between the forms rich in hooks (*A. uncinatum*) and those totally lacking in them (*A. venulosum*) could be discerned; further, fertile *A. uncinatum* is itself devoid of the hook form. Distinctions between these two taxa not being clearly established by recent work, Boudouresque et al. preferred to regard *A. venulosum* simply as a variety of *A. uncinatum* (*A. uncinatum* var. *venulosum* (Zanardini) Boudouresque et al.). Pending further study, we have maintained the taxa as separate entries.

Acrosorium spp.
Namibia (348; 522).

Note. For possible specific attributions, see the entries for *Acrosorium acrospermum* and *A. maculatum*. M. J. Wynne is currently studying collections, his own and some previous, of Delesseriaceae from the region. The report in Lawson & Isaac (348) is based directly on data in Simons (522).

Acrosymphyton purpuriferum (J. Agardh) Sjöstedt
See *Helminthopsis purpurifera* (J. Agardh) Papenfuss.

Acrothamnion butleriae (Collins) Kylin
[As *Antithamnion butleriae* Collins]
Sierra Leone (295; 350).
'tropical parts of the Atlantic Ocean' (350).

Actinococcus latior Schmitz
Namibia (156; 348; 453; 522).

Note. Pilger (453) provided the basis for the inclusion of this species in Lawson & Isaac (348); his record was also repeated in 156 (Dinter), although a new record for Walfischbai was then also added. Schmitz (1893: 387) detailed the differences between taxa he recognised as *Actinococcus latior* and *A. aggregatus*, the latter from South Africa. The relationships between *Actinococcus*, *Phyllophora*, and *Gymnogongrus* are referred to in Simons (522).

Actinotrichia fragilis (Forsskål) Børgesen)
[As *Actinotrichia rigida* (Lamouroux) Dcne]
Mauritanie (unpublished).

Note. The synonymy follows Cribb (113: 25).

Actinotrichia lapidescens Schmitz

Note. See the entries for *Galaxaura lapidescens* (Ellis & Solander) Lamouroux and *G. rugosa* (Ellis & Solander) Lamouroux. A specimen of Vickers's (547) original material from the Canaries was examined by Børgesen (68: 70); he considered it a tetrasporic [*Galaxaura flagelliformis*] plant. This latter taxon was subsequently attributed to the synonymy of *G. elongata* J. Agardh, itself now generally considered (Papenfuss et al., 436: 421–424; Cribb, 113: 26–27) to lie within the synonymy of *G. rugosa*. More recently, however, *G. flagelliformis* has been placed in synonymy with *G. lapidescens* (436: 407). The status of other material within the application of this name by Vickers remains to be established, but on the assumption of homogeneity, we have included the records within the entry for *G. lapidescens* (q.v.). Characteristics said to distinguish *Actinotrichia* from *Galaxaura* are the presence of persistent assimilatory filaments, and the absence of tetrasporophyte/gametophyte dimorphism, in the former.

Actinotrichia rigida (Lamouroux) Decaisne
See *Actinotrichia fragilis* (Forsskål) Børgesen.

Aeodes orbitosa (Suhr) Schmitz
Namibia (312A; 348; 437; 438; 522; 523; 525; unpublished).

Note. For distinctions between species in this genus see Chiang (102: 15). Kraft (1977) gave cogent comments on generic criteria within the Cryptonemiaceae, including *Aeodes*.

Aeodes sp
Namibia (522).

Agardhiella tenera (J. Agardh) Schmitz
See *Solieria filiformis* (Kützing) Gabrielson.

Agardhiella sp.
Sénégal (182; 531).

Note. At least part of the overall statement in Feldmann & Bodard (182) relates to *Solieria filiformis* (q.v.). G. Feldmann & Bodard indicated: 'deux *Agardhiella* dont *A. tenera* (J. Ag.) Schm.'. The nature of the other species/specimens seems not to have been definitively established, at least in print.

Aglaophyllum laceratum Montagne and var. **uncinatum** Turner
See *Acrosorium uncinatum* (Turner) Kylin.

Aglaothamnion decompositum (J. Agardh) L'Hardy-Halos [or (Grateloup) L'Hardy-Halos]
See *Callithamnion decompositum* J. Agardh.

Aglaothamnion furcellariae (J. Agardh) G. Feldmann [or Feldmann-Mazoyer]
See *Callithamnion byssoides* Arnott ex Harvey in W. Hooker.

Aglaothamnion gallicum (Nägeli) Halos
See *Callithamnion gallicum* Nägeli and *Callithamnion roseum* sensu Harvey.

Aglaothamnion scopulorum (J. Agardh). G. Feldmann [or other authorities]
See *Callithamnion hookeri* (Dillwyn) S. F. Gray.

Aglaothamnion tripinnatum *auct.*
See *Callithamnion tripinnatum* C. Agardh.

Aglaothamnion spp.
See *Callithamnion* spp.

Ahnfeltia concinna J. Agardh
Cape Verde Islands (38; 145).

Note. Ahnfeltia in general probably involves crustose stages in the life-histories; certainly this is so for *A. plicata* (Hudson) Fries, where the crustose sporophyte was previously known as *Porphyrodiscus simulans* Batters (Farnham & Fletcher, 1976). Masuda (1982), investigating *A. concinna*, indicated the presence of a crustose phase that differs from that of *A. plicata*, the type species; he considered that the species should be placed in *Ahnfeltiopsis* Decew & Silva. Magruder (1977) recently dealt with the triphasic life-history of *A. concinna*.

Ahnfeltia elongata Montagne
See *Chondrus elongatus* Montagne.

Ahnfeltia gigartinoides J. Agardh.
Cape Verde Islands (38; 145).

Ahnfeltia plicata (Hudson) J. Agardh
Ascension (37).
'croît de l'Islande aux Canaries' (89).

Note. See the entry for *Ahnfeltia concinna* J. Agardh. For data on the *A. plicata* sporophyte, see also Chen (1977). Further confirmation is needed of the presence of *A. plicata* in the list area.

Ahnfeltiopsis Decew & Silva
See the note to *Ahnfeltia concinna* J. Agardh.

Alsidium corallinum C. Agardh
Canaries (38D; 44; 71; 177; 184; 190; 191; 226; 227; 375; 392; 401; 439; 547).
Mauritanie (184).

Note. Edelstein (177) gave the authority as J. Agardh. Some of the records above (71; 439) were based only on small fragments or poorly-developed sterile specimens.

Alsidium triangulare (L.) J. Agardh [or other authority combinations]
See *Bryothamnion triquetrum* (S. Gmelin) Howe.

Amansia multifida Lamouroux
[As *Epineuron* (?) *multifidum* (Lamouroux) Kützing]
'In mari atlantico tropico ad oras Africae' (318).
'in oceano Atlantico ad littus Africae provenientum memoravit Kützing' (133).

Note. Included for completeness only. There is no direct evidence, in the absence of other records, that the phraseology used involves our present area; the herbarium at Leiden has not been checked for confirmation, although Kützing's entry was apparently based on material provided by Montagne and Binder.

Amphiroa anceps (Lamarck) Decaisne
[As *Amphiroa dilatata* Lamouroux]
Sénégal (122; 529).

Note. Sourie (529: 206) commented that probably two species of *Amphiroa* were involved in his area, one identified by Dangeard as *A. cryptarthrodia* (q.v.), the other 'correspond probablement à l'espèce nominée par le même auteur *A. dilatata* Lamouroux'. The equivalence of *A. dilatata* with *A. anceps* was concluded by Weber-van Bosse (1904: 94), in commenting: 'My collections give me entire justification for sinking *A. dilatata* in *A. anceps*, which name as the older one must be maintained.' The same conclusion was reached by Seagrief (1984), partly on the basis of a personal communication from H. W. Johansen. Norris & Johansen (417: 12–13), studying material from the Gulf of California, maintained the name *A. brevianceps* Dawson for a taxon they considered 'closely related to *Amphiroa anceps* (Lamarck) Decaisne . . . a widespread species in subtropical and tropical areas of the world'; more material is needed fully to resolve the status of that relationship.

Amphiroa annobonensis Pilger
See *Amphiroa beauvoisii* Lamouroux.

Amphiroa annulata Lemoine
Mauritanie (349).

Note. This report represents an unusual species for the region; the determination was confirmed by H. W. Johansen (in litt., 2 February 1976), who commented that the taxon 'most certainly has an earlier name'.

Amphiroa beauvoisii Lamouroux
Angola (298; 352).
Canaries (18; 375).
Congo (249; 250).
Côte d'Ivoire (287; 288; 350).
Gambia (296; 350).
Ghana (288; 299; 300; 350; 376; 377).
Liberia (129; 287; 350).
St Helena (541).
Sénégal (59; 529).
Senegambia (319).
'Atlantique tropicale' (529).
'Atlantischen Ozean, von der spanisch-portugiesischen Küsten an südwärts bis zum Kap der Guten Hoffung' (499).
'Nordwestafrika' (499).
'warm temperate and tropical parts of the Atlantic Ocean' (350).
[As *Amphiroa annobonensis* Pilger]
Pagalu (139; 397; 455; 457).
[As *Amphiroa exilis* Harvey]
St Helena (142; 260; 391).
[As *Amphiroa linearis* Kützing]
Gabon (134; 319; 350; 417).
'known only from tropical West Africa' (350).
'Ad litora Africae occidentalis . . . widespread in distribution in tropical and subtropical areas of the Atlantic and Indian Oceans' (417).

Note. The conspecificity of *Amphiroa annobonensis* with *A. beauvoisii* is accepted here following comments by H. W. Johansen; see, for these, 350: 225. Records in Sourie (529) were given with some doubt as to determination. The statement by Bodard & Mollion (59) that this species is 'absente des îles de l'Atlantique' was clearly in error; it has been reported from the Açores (33: 108) and Madeira (375). Kützing's (319) report from Senegambia was based on Herb. Sonder material. Norris & Johansen (417: 12) observed: 'In all likelihood, *A. beauvoisii* is the most widespread species of *Amphiroa*, perhaps occurring in most tropical and subtropical areas where the genus may be found.' Dickie's (142) material from St Helena was in such fragmentary condition that he 'mark[ed] it as rather doubtful'. Pilger (455: 429) indicated his *A. annobonensis* as close to *A. exilis*, but listed what he then considered distinguishing characteristics; these latter are no longer accepted as valid. The acceptance of *A. linearis* Kützing as conspecific with *A. beauvoisii* follows Norris & Johansen (417: 6, 12).

Amphiroa brevianceps Dawson
See the entries for *Amphiroa anceps* (Lamarck) Decaisne and *Amphiroa peruana* Areschoug.

Amphiroa capensis Areschoug in J. Agardh
São Tomé (251; 263; 264; 265; 350; 535).

Note. There is confusion in the literature as to the status of Areschoug's involvement as author, but since the section on Corallineae (pp. 506–576) in J. Agardh's work (25) is acknowledged as being taken directly from the MSS sent by Areschoug 'intactum', with some additional Agardh data, there is scant reason for denying the credit to Areschoug. The above records are principally reported as simply 'Areschoug' or 'Areschoug ex J. Ag.' for authorities; since no confusion is so produced, sub-headings have not been here used. Steentoft (535), dealing with material determined by Henriques (263; 264; 265), stated of a specimen 'consists only of fragments, and showed little resemblance to the authentic specimen of *A. capensis* Aresch. seen (in HBG). It seems best to leave this material without specific determination.' The record has therefore, in the Steentoft form, been attributed both here and at *Amphiroa* spp. This Steentoft statement, repeated in 350: 228, caused Lawson & John to include the report of *A. capensis* from São Tomé as a doubtful record. Weber-van Bosse (1904: 99) synonymised *A. capensis* Areschoug with *A. involuta* Kützing, in her 'synoptical key'. See also the entry for *Amphiroa* spp.

Amphiroa cryptarthrodia Zanardini
Canaries (38B; 50; 70; 188; 191; 227; 292; 375; 439; 499).
Salvage Islands (38B; 556A).
Sénégal (38B; 50; 122; 292; 529).

Note. Confusion between this taxon and *Amphiroa fragilissima* (L.) Lamouroux seems to have been quite frequent; apart from the case of the Canaries records (see above), Bodard (50) commented also for Sénégal that he had only once found *A. cryptarthrodia*, amongst *Falkenbergia hillebrandii* as a non-attached tuft, and that it closely resembled *A. fragilissima* 'avec lequel nous l'avions confondu d'abord.' The Ghanaian record, in John & Lawson (292), of *A. cryptarthrodia* is actually representative of *Amphiroa rigida* Lamouroux. Sourie (529: 206) indicated *A. cryptarthrodia* to be the dominant of the two *Amphiroa* spp. that he recognised for Sénégal. Weber-van Bosse (1904: 100) indicated *A. cryptarthrodia* to be a synonym of *A. verrucosa* Kützing, whilst Børgesen (70), seeing a specimen from Piccone's herbarium, was not quite sure as to the specific determination of that Canary Islands material.

Afonso-Carrillo et al. (18: 46) commented, for all records for the Canary Islands, that the name *A. cryptarthrodia* Zanardini should be eliminated from the catalogue of accepted species, since it was: 'con seguridad confundida con *A. fragilissima*'.

Amphiroa dilatata Lamouroux
See *Amphiroa anceps* (Lamarck) Decaisne.

Amphiroa ephedraea (Lamarck) Decaisne
Senegambia (224).
[As *Amphiroa emphaedraea* (Lamarck) Decaisne]
Senegambia (296).

Note. Gerloff (224) recorded the location as 'Angola Bay, Senegambien', mentioning also 'Kap [der Guten Hoffnung]'. It seems very possible that this former locality is a mis-citation of Algoa Bay, South Africa; Seagrief (pers. comm., 5 February 1982) has confirmed that *Amphiroa ephedraea* is very common in the lowest part of the tidal excursion in Algoa Bay. John & Lawson (296: 293) repeated the Gerloff record. Norris & Johansen (417: 24–25) considered *A. ephedraea*, with its mostly terete intergenicula, superficially to resemble *A. vanbosseae* Lemoine (q.v.).

Amphiroa exilis Harvey
See *Amphiroa beauvoisii* Lamouroux.

Amphiroa fragilissima (L.) Lamouroux
Ascension (475).
Canaries (9; 13; 226; 227; 306B; 379).
Cape Verde Islands (191).
Mauritanie (349).
St Helena (541).
Sénégal (59).
'atlantique tropicale' (59).
'Common in all warmer seas' (200).
[As *Amphiroa fragilissima* L.]
Cape Verde Islands (145).
[As *Amphiroa fragilissima* Lamouroux]
Cape Verde Islands (38; 259).
St Helena (142; 259; 260; 391).

Note. See *Amphiroa cryptarthrodia* for probable additional records of the present taxon. The confusion between these taxa and in the application of the names is evident from the terminal note there.

Amphiroa involuta Kützing
See *Amphiroa capensis* Areschoug in J. Agardh.

Amphiroa linearis Kützing
See *Amphiroa beauvoisii* Lamouroux.

Amphiroa peruana Areschoug
Côte d'Ivoire (287; 288; 350).
Ghana (288; 350).
Liberia (287; 288; 350).
'in tropical parts of the Atlantic and Pacific Oceans' (350).
[As *Amphiroa brevianceps* Dawson]
Ghana (292).

Note. The Ghanaian material referred to by John & Lawson (292) was misdetermined; this record does not challenge the nomenclatural and taxonomic opinion expressed by Norris & Johansen (417: 12–13) that *Amphiroa brevianceps* Dawson may be closely related to *A. anceps* (Lamarck) Decaisne.

Amphiroa rigida Lamouroux
Ascension (474).
Cameroun (350).
Canaries (556A).
Ghana (299; 350; 376; 491).
'in warm temperate and tropical parts of the Atlantic Ocean' (350).
[As *Amphiroa cryptarthrodia* Zanardini]
Ghana (292).
[As *Amphiroa* sp., aff. *rigida* Lamouroux]
Gabon (unpublished).

Note. The Gabon material mentioned above is from the same collection as that reported for Gabon in the entry for *Amphiroa* sp. This material was sent for examination subsequently to H. W. Johansen, who did not express any contrasting opinion.

Amphiroa subcylindrica Dawson
Mauritanie (349).

Note. Lawson & John (349: 113) commented that this species had not previously been reported outside the Pacific region. Their determination was confirmed (in litt., 2 February 1976) by H. W. Johansen, who also indicated that he was applying the Dawson name only 'until an earlier name is found'. The latter has now been achieved – Norris & Johansen (417: 23–25) placed *A. subcylindrica* of Dawson unequivocally in the synonymy of *Amphiroa vanbosseae* Lemoine.

Amphiroa vanbosseae Lemoine
See the entry for *Amphiroa subcylindrica* Dawson.

Amphiroa verrucosa Kützing
See the entry for *Amphiroa cryptarthrodia* Zanardini.

Note. On the rendering of this specific epithet, see Weber-van Bosse (1904: 100–101). The same work has some explanation of past disagreements on the conspecificity of *Amphiroa verrucosa* and *A. cryptarthrodia*. Boudouresque et al. (1984: 46) continued to employ the epithet in the form of *A. verruculosa* Kützing.

Amphiroa spp.
Ascension (474).
Bioko (500).
Cameroun (500).
Gabon (294).
Ghana (299; 344; 377; 487; 491; 567).
Guinea-Bissau (529).
Guinée (344; 529).
Pagalu (500).
São Tomé (535).
Sénégal (59; 529; 530).
'West Africa' (290; 344).

Note. John & Lawson (294) were reporting a vegetative plant, from Gabon, similar to *Amphiroa rigida*, but with some anatomical differences; see also the note at *A. rigida*. The report from Ghana (299) concerned a very broad form from deep water; H. W. Johansen was unable to reach a satisfactory conclusion on this material. Steentoft's (535) record from São Tomé was based on specimens determined by Henriques (263; 264; 265) as *Amphiroa capensis* Areschoug; see the entry for the latter for further explanation.

Anatheca dentata (Suhr) Papenfuss
See *Anatheca montagnei* Schmitz in Engler & Prantl.

Anatheca montagnei Schmitz
Gambia (296).
Ghana (290; 292; 299; 350; 376).
Sénégal (49; 50; 52; 56; 131; 182; 272A; 290; 292; 329; 350; 390; 394; 400; 513; 531).
Sénégal (Casamance) (390).
Senegambia (390; 503).
[As *Anatheca montagnei* J. Agardh]
Sénégal (59).
[As *Anatheca montagnei* (J. Agardh) Schmitz]
Sénégal (59; 399).
[As *Anatheca dentata* (Suhr) Schmitz]
Sénégal (Casamance) (99).
'in warm temperate and tropical seas' (350).
[As *Callymenia dentata* J. Agardh]
Cape Verde Islands (38).
Sénégal (38).
[As *Callymenia dentata* (Suhr) J. Agardh]
Sénégal (408).

Note. Sénégal records in references 38, 131, 329, and 390 concern the island of Gorée. Askenasy's (38) record from the Cape Verde Islands is based on reasoning, not on material, and appears still to require confirmation. He commented: 'n'ont pas été rapportées des îles du Cap Vert; il est très probable qu'elles y croissent aussi et qu'on les trouvera plus tard'. See also the entry for *Euhymenia schizophylla* Kützing.

Anotrichium barbatum (C. Agardh) Nägeli
[As *Griffithsia barbata* (J. E. Smith) C. Agardh]
Canaries (38B; 38C; 38D; 71; 128A; 191; 227; 232B; 239; 306B; 547; 556).
Salvage Islands (38B; 38C; 38D; 556; 556A).

Sierra Leone (30; 350).
'Atlantique, de l'Angleterre aux Canaries' (190; 196).
'English coast southwards to the Canary Islands' (71).
[As *Griffithsia barbata* J. Agardh]
Canaries (439).

Note. Reasoning by Baldock (1976) for recognition of *Anotrichium* as a genus is presented in the entry for *Monosporus pedicellatus* (q.v.). Use of this generic name is increasing – see, for example, Kapraun (1980). The record from Sierra Leone (Aleem, 30) represents the first mention from mainland Western Africa and, although repeating the record, Lawson & John (350) have expressed doubt as to the specific determination. The latter requires fertile material; Aleem's record was based on floating plants reported in the dry season.

Anotrichium furcellatum (J. Agardh) Baldock
See *Griffithsia arachnoidea* C. Agardh.

Anotrichium multiramosum (Setchell & Gardner) Baldock
See *Griffithsia arachnoidea* C. Agardh.

Anotrichium tenue (C. Agardh) Nägeli
Canaries (392).
'world-wide tropical and subtropical (to temperate) distribution.' (534).
[As *Griffithsia tenuis* C. Agardh]
Angola (352).
Canaries (13; 38B; 38C; 38D; 71; 191; 196; 227; 232B; 306A; 375; 555; 556).
Cape Verde Islands (38B; 38C; 38D).
Salvage Islands (38B; 38C; 38D; 231; 375; 555; 556; 556A).
Sénégal (38B; 38C; 38D; 529; 555; 556).
'Africa' (74).
'Pantropical' (529).
[As *Griffithsia tenuis* (Harvey) C. Agardh]
Canaries (78).
'widespread in tropical and subtropical seas, extending into warm temperate regions' (561).
[As *Griffithsia tenuis* J. Agardh]
Canaries (177; 547).
Sénégal (122; 411).
'Atlantic Ocean (European and African coasts, Canary Islands . . .)' (177).

Note. Although many authors continue to employ the combination in *Griffithsia*, that in *Anotrichium*, as discussed and rationalized in Baldock (1976), has been accepted in many recent Australian and American publications (e.g. 416; Kapraun, 1980). We have adopted use here of both *Anotrichium* and the associated form genus *Monosporus*; for a full explanation see the entry for *Monosporus pedicellatus*. For more recent comments on the conspecificity of the Mediterranean *Griffithsia tenuis* with the Atlantic/Indo-Pacific taxon here and commonly referred to as *Anotrichium tenue* (although by some suggested perhaps to be *Griffithsia thyrsigera*), see Norris & Aken (417A: 60). Stegenga (534) has also recently shown that the southern African *Griffithsia secunda* Harvey ex J. Agardh (type from Muizenberg, Cape Province, South Africa) is a synonym of *Anotrichium tenue*; Stegenga (534: 154) has proposed to recognise the Cape material as *Anotrichium tenue* var. *secundatum* (Harvey ex J. Agardh) Stegenga. He suggested, furthermore (534: 154), that intermediate manifestation of some aspects of varietal difference in Transkei and eastern Cape Province plants of *A. tenue* may indicate clinal variation patterns along the South African coast. This may apply more widely to the whole of the list area distribution of the species.

Antithamnion antillanum Børgesen
Canaries (0; 13; 16; 71; 91A; 191; 225; 227; 235; 253; 379; 495; 561).
'Widespread in warm seas' (559).

Note. For general background to both nomenclature and taxonomy in this species, see Abbott (1979; 1984). It is possible (see Athanasiadis, 38A: 458, 460) that *all* Canaries material referred by Børgesen (71) to *Antithamnion antillanum* is actually representative of *A. ogdeniae* Abbott (q.v.). All other Canaries reports will require re-examination on the same basis.

Antithamnion butleriae Collins
See *Acrothamnion butleriae* (Collins) Kylin

Antithamnion cruciatum (C. Agardh) Nägeli
Canaries (38B; 38D; 71; 128A; 191; 227; 253; 375; 392; 490).
Cape Verde Islands (38; 38B; 38D; 239).
Salvage Islands (38B; 38D; 556A).
Sénégal (38B; 38D; 59).
'Atlántico (Noruega – Canarias . . .)' (253).
'Atlantique (de la Scandinavie aux Canaries . . .)' (33).
'desde Escandinavia a Canarias' (546).
[As *Antithamnion cruciatum* Nägeli]
Canaries (191; 493).
Cape Verde Islands (38).
[As *Antithamnion cruciatum* (C. Agardh) Nägeli var. *profundum* G. Feldmann]
'Atlantique nord, de la Scandinavie aux Canaries' (196).
[As *Antithamnion cruciatum* (C. Agardh) Nägeli var. *typicum*]
'Atlantique nord, de la Scandinavie aux Canaries' (190; 196).

Note. For the distinctions between this taxon and *Antithamnion antillanum*, consult the sources cited by Abbott (1979). Sauvageau's (493) material from the Canaries was 'très jeune'. See also comments in Wynne (36B) regarding resemblances between *Antithamnion cruciatum* and *Antithamnion leptocladum* (Montagne) Wynne.

Antithamnion defectum Kylin

Note. See the entry for *Antithamnion* spp., Sierra Leone records, which may conceal material legitimately to be considered as representative of this taxon. Lee & Boo (1982) achieved partially successful interspecific crosses between Californian *A. defectum* and *A. sparsum* Tokida, in culture, suggesting that both species may be actively speciating. See comments in Wynne (36B) regarding *A. defectum*/*A. leptocladum* similarities and differences.

Antithamnion elegans Berthold
See *Antithamnionella elegans* (Berthold) J. Price & D. John

Antithamnion leptocladum (Montagne) Wynne
Namibia (36B).

Note. Reasons for both reallocation to this genus and recording from Namibia are presented by Wynne (36B).

Antithamnion ogdeniae Abbott
Canaries (38A).
[As *Antithamnion antillanum* Børgesen]
Canaries (71).

Note. It is possible that *all* material reported, under the name *Antithamnion antillanum* Børgesen, by Børgesen (71) from the Canaries should actually be attributed here. See Athanasiadis (38A: 458, 460). The same may apply to other reports of *A. antillanum* from the Canaries, since probably based on Børgesen's original descriptive data.

Antithamnion plumula (Ellis) Thuret
See *Pterothamnion plumula* (Ellis) Nägeli.

Note. Not all authors have agreed with the resuscitation of *Pterothamnion* and the reassignment there of the previous *Antithamnion plumula*. An outstanding example is provided by recent southern French work, in turn exemplified by the recent checklist of benthic marine algae of Pyrénées-Orientales (Boudouresque et al., 1984). There (p. 49), the authors recombine this species as *Platythamnion plumula* (Ellis) Boudouresque et al., recognising the varieties *plumula, bebii* [sic!] (Reinsch) J. Feldmann, and *crispum* (Ducluzeau) Hauck. Until the situation is satisfactorily resolved, we maintain the taxon in *Pterothamnion*.

Antithamnion pteroton Bornet
Canaries (71; 89; 133; 191; 227).

Note. Bornet (89: 332) went into considerable detail on the resemblances and differences in anatomy between this species, *Ptilothamnion pluma, Gymnothamnion elegans*, and *Callithamnion micropterum*.

Antithamnion spp.
Bioko (350).
Canaries (3; 489).
Gabon (294).
Ghana (299; 376; 377).
Namibia (348; 522).
Salvage Islands (38B; 231).
Sénégal (50; 55).
Sierra Leone (295; 350).
Togo (293).

Note. The above records from Sierra Leone represent material with a close resemblance to *Antithamnion defectum* (q.v.) but with differences in some aspects of branching pattern; see Lawson & John, 350: 309–310, for details.

Antithamnionella elegans (Berthold) J. Price & D. John, **comb. nov.**
Basionym: *Antithamnion elegans* Berthold in *Mitt. zool. Stn Neapel* **3**: 516 (1882).
[As *Antithamnionella elegans* (Berthold) Boudouresque & Perret]
Canaries (13; 227; 232B; 253; 306B).
'Atlántico (Golfo de Vizcaya – Canarias . . .)' (253).
[As *Antithamnion elegans* Berthold]
Angola (352).
Canaries (4; 5; 16; 33; 71; 86; 190; 191; 196; 225; 235; 236; 237; 238; 293; 350; 375; 388; 489; 490; 512A; 556).
Ghana (299; 300; 350; 376; 377; 491).
Salvage Islands (38B; 231; 556).
Sénégal (59; 122; 556).
Togo (293; 350).
'Atlantischer Ozean von den skandinavischen Küsten südwärts bis zum Kap' (498A).
'warm temperate and tropical parts of the Atlantic Ocean' (350).

Note. Weisscher (556: 58) repeated the earlier record for the Salvage Islands in 231, but did not locate additional field-material. Boudouresque et al. (1984: 48) referred to this taxon but quoted the authorities as '(Berthold) Boudouresque et Verlaque'. This form of attribution is in error since, although Boudouresque & Verlaque (91A: 59) referred to the taxon as '*Antithamnionella elegans* (Berthold)', thereby being completely unequivocal, they failed to present a full citation of the basionym publication details (cf. *Int. Code Bot. Nomenclature,* 1983, Art. 33.2). These details were also omitted from subsequent references to the taxon in Boudouresque & Perret (1977: 63) and from Boudouresque et al. (1984: 48). None of these works therefore effects correctly the recombination and we have been obliged fully to publish the data here in order to authenticate the use of *elegans* in *Antithamnionella*.

Aphanocladia cf. **stichidiosa** (Funk) Ardré
Canaries (556A; 557).

Note. Clarification of the nature and attribution of this material is desirable.

Apoglossum ruscifolium (Turner) J. Agardh
Sénégal (38D; 55; 59).
Western Sahara (349).
'Atlantique (de l'Angleterre au Rio de Oro)' (33).
'Atlantique: depuis les côtes anglaises jusqu'au Rio de Oro' (222).
'from Scandinavian waters southward [to] . . . northwest and southern Africa' (159A).
[As *Delesseria ruscifolia* J. Agardh]
Cape Verde Islands (38).
Sénégal (38).
[As *Delesseria ruscifolia* (Turner) Lamouroux]
Sénégal (408).
[As *Delesseria ruscifolia* Lamouroux]
'De Suède au Sénégal' (89).

Note. The statement of record in Lawson & John (349: 113) is based solely on data in Gayral (222) and Andrė (33). The Cape Verde Islands report in Askenasy (38) is derived from reasoning, not from material; he stated 'n'ont pas été rapportés des îles du Cap Vert; il est très probable qu'elles y croissent aussi et qu'on les trouvera plus tard'.

Archaeolithothamnion [-ium] africanum Foslie
See *Sporolithon africanum* (Foslie) Afonso-Carrillo.

Aristothamnion collabens (Rudolphi) Papenfuss
Namibia (36B; 348; 522).
[As *Aristothamnion purpuriferum* J. Agardh]
Namibia (157).
Note. See Papenfuss (434) for taxonomic and nomenclatural background. Wollaston (559: 286) did not mention Namibia in her statement of the distribution of the species.

Aristothamnion purpuriferum (Kützing) J. Agardh
See *Aristothamnion collabens* (Rudolphi) Papenfuss.

Arthrocardia attenuata Manza
Namibia (348; 522).
Note. Data in Lawson & Isaac (348) are based directly and solely on Simons (522). The genus and large numbers of species (at least 16) are recorded from South Africa and it is therefore probable that the few records from the south of the present list area constitute under-representation in both taxa and distribution. Taxon limits appear to be confused, as does application of names; Seagrief (1984) indicated (p. 6) that *Arthrocardia attenuata* should be reduced to the synonymy of *A. palmata* (Ellis & Solander) Areschoug in J. Agardh, following H. W. Johansen (pers. comm., 1970). Doubt as to accuracy of determination in these records has prevented that course of action here.

Arthrocardia capensis (Leach in Decaisne) Areschoug in J. Agardh
Note. See the notes on the opinion expressed by Askenasy (38) in the entry for *Corallina officinalis* L. Seagrief (1984: 5) reduced the present taxon to the synonymy of *Corallina berterii* Montagne ex Harvey (q.v.).

Arthrocardia carinata (Kützing) Johansen in Seagrief
St Helena (541).
[As *Corallina carinata* Kützing]
Namibia (160; 348; 453; 500; 522).
St Helena (142; 260; 391).
'warm Atlantic' (40).

Arthrocardia filicula (Lamarck) Johansen in Seagrief
[As *Arthrocardia setchellii* Manza]
Namibia (522).

Arthrocardia flabellata (Kützing) Manza
Note. See the notes to *Corallina* sp. regarding possible Namibian material of this taxon.

Arthrocardia lobata Montagne
Canaries (403).
Note. Montagne (403: 130), in the entry for his new taxon *Corallina microptera*, commented on its occurrence on Tenerife as 'avec *Arthrocardia lobata* Nob.'. There seems to be no subsequent recognition of this brief reference to the plant, nor development of further information on what it represents. The relationship with *Corallina lobata* Lamouroux (q.v.) is therefore unclear. The record is here referred to for completeness only.

Arthrocardia palmata (Ellis & Solander) Areschoug in J. Agardh
Note. See the entry for *Arthrocardia attenuata* Manza. In view of the suggested synonymy, entries there may represent records of the present species.

Arthrocardia setchellii Manza
See *Arthrocardia filicula* (Lamarck) Johansen in Seagrief.

Arthrocardia spp.
Namibia (348; 437; 438; 522).

Note. Recording in Lawson & Isaac (348) is based directly on data in the other references. All records may represent the entity here recorded under *Arthrocardia attenuata* Manza, whatever name is finally to be correctly applied. We have not seen any of the material in question; so many species were described or recorded from South Africa and possibly implicated in the Namibia marine flora that definitive allocation would at present be entirely arbitrary.

Asparagopsis armata Harvey
Canaries (8; 13; 16; 38B; 38D; 226; 227; 304; 306B; 379; 489; 490).
Salvage Islands (38B; 38D; 556A).
[As *Falkenbergia rufolanosa* (Harvey) Schmitz]
Canaries (13; 489).
Sénégal (47; 122; 296; 529).

Note. There is occasional difficulty in being certain as to which 'species' of *Asparagopsis* is present when, especially at range peripheries, only the asexual ('*Falkenbergia*') phase has apparently established itself. It is not possible certainly to distinguish between the asexual phases of *A. armata* and *A. taxiformis* purely on grounds of morphology, despite the earlier use of two distinct names (*F. rufolanosa*; *F. hillebrandii*) for cases where geography/range or completed life-history made it clear which sexual phase 'species' was involved. Considerable overlap in the ranges of the two *Asparagopsis* spp. within the present area complicates that issue. There is, additionally, considerable doubt as to the validity of recognition of two species in *Asparagopsis*, at least on the present slender morphological basis. The existing nomenclatural mode of reporting authors has therefore been maintained pending further elucidation.

Asparagopsis delilei Montagne
See *Asparagopsis taxiformis* (Delile) Trevisan.

Asparagopsis taxiformis (Delile) Trevisan
Canaries (8; 38B; 38C; 38D; 175; 180; 226; 227; 237; 296; 302; 306B; 351; 544).
Ghana (299; 346; 347; 350; 376; 377).
Liberia (350).
Nigeria (346; 347; 350).
Salvage Islands (38B; 38C; 38D).
'in warm temperate and tropical parts of the Atlantic and Pacific Oceans' (350).
[As *Asparagopsis taxiformis* (Delile) Collins & Hervey]
Canaries (5; 13; 15; 16; 63; 70; 96; 97; 188; 191; 229; 235; 301; 302; 304; 351; 372; 373; 375; 489; 490; 493; 556; 557).
Ghana (153).
Liberia (129).
Salvage Islands (231; 375; 556; 556A).
'existe seul aux Antilles et aux Canaries' (188).
[As *Asparagopsis Delilei* Montagne]
Canaries (25; 26; 27; 37; 89; 132; 143; 144; 258; 259; 318; 322; 387; 401; 407; 439; 493; 495; 499; 547; 557A).
Pagalu (456; 457).
'Mittelmeer und angrenzende Teile des Atlantischen Ozeans, nach Süden bis nach . . . Westafrika sich erstreckend.' (498).
'Westafrika' (499).
[As *Asparagopsis Delilei* Montagne f. *genuina*]
Canaries (495).
[As *Asparagopsis Delilei* (Montagne) Montagne]
Canaries (508).
[As *Dasya delilei* Montagne]
Canaries (44; 401).
[As *Falkenbergia hillebrandii* (Bornet) Falkenberg]
Canaries (13; 38B; 38C; 38D; 63; 71; 133; 139; 179; 304; 351; 498; 499; 556).
Cape Verde Islands (50).

Ghana (153; 299; 338; 347; 376; 377; 491).
Liberia (129).
Nigeria (347).
Salvage Islands (38B; 38C; 38D; 556; 556A).
Sénégal (47; 50; 529).
'Pantropical' (529).
[As *Falkenbergia Hillebrandii* Falkenberg]
Canaries (494).
[As *Falkenbergia* . . . Schmitz. (*Nitophyllum* ? *confervaceum* Berthold; *Polysiphonia hillebrandii* Bornet)]
Canaries (547).
[As *Lictoria taxiformis* (Delile) J. Agardh]
Canaries (23).

Note. Some of the above records (e.g. that in Weisscher, 556, of *Falkenbergia hillebrandii* from the Salvage Islands) expressed clearly the sort of determinatory doubt detailed in the note to the entry for *Asparagopsis armata* (q.v.). According to Weisscher (556), sexual phase plants were only few and small in the Salvage Islands. De May et al. (129) recorded both sexual (*Asparagopsis*) and asexual (*F. hillebrandii*) phase plants from Liberia.

Asparagopsis sp.
[As *Asparagopsis* sp.]
Canaries (2; 301).
Gambia (296; 350).
[As *Falkenbergia* sp.]
Guinée (529).

Note. For explanation of some aspects of the imprecise determinations, see the entry for *Asparagopsis armata*.

Audouinella
'The generic classification of acrochaetioid algae is in a disgraceful state of disarray' (Woelkerling, 1983: 78).

Whilst the reduction of all such genera as *Acrochaetium, Audouinella, Balbiania, Chromastrum, Colaconema, Kylinia, Liagorophila, Rhodochorton, Rhodothamniella,* and so on, to combinations in *Audouinella* has considerable logic and convenience value, many European phycologists (especially the French and the Dutch) regard that process as obscuring realities of relationship on the basis of life-history, plastid form, and similar characteristics (see especially Stegenga & Van Erp, 1979). Dixon (in Dixon & Irvine, 1977) provided a detailed explanation of historical background and treatment to that time; this has been subject recently to refocussing and updating by Woelkerling (1983), in his most useful review of the *Audouinella* complex. The vast majority of relevant literature is traceable through one or other of these sources.

Acceptance of the reduction to a single genus has resulted in the need for large numbers of new nomenclatural combinations, many of which were effected by Garbary (1979), in examining the numerical taxonomy of the Acrochaetiaceae, and by Garbary et al. (1983). Although there is merit in Stegenga's (1979) use of the sexual cycle as the primary generic criterion (generally supported by West & Hommersand, 1981, and by Woelkerling, 1983), we do not employ the distinction for nomenclatural purposes here. In many cases, data required to carry out transfers and name-changes are quite simply not available for taxa recorded from the area under consideration. The adoption here of the single genus *Audouinella* has resulted in the requirement for a further seven new combinations, detailed under individual entries later.

In summary, we would firmly support Woelkerling's (1983) statement that: 'it is more important to accumulate detailed, trustworthy data on numerous species than to engage in endless manipulation of generic schemes'.

Audouinella bispora (Børgesen) Garbary
See the note to *Audouinella dasyae* (Collins) Woelkerling.

Audouinella byssacea (Kützing) J. Price, **comb. nov.**
Basionym: *Callithamnion byssaceum* Kützing, *Phycologia generalis*: 371 (1843); see also Kützing's *Species algarum*: 639 (1849).
[As *Acrochaetium byssaceum* (Kützing) Askenasy]
Cape Verde Islands (38).

Note. Purely on nomenclatural grounds, this record should possibly appear under *Audouinella saviana* (Meneghini) Woelkerling. De Toni (139: 59) commented of *Chantransia mollis* Pilger (454: 298): 'Affinis videtur *Chantransia Savianae* (Menegh.) Ardiss.' Pilger (454) had indicated that his new species *C. mollis* was very similar to *Callithamnion (Chantransia) byssaceum* Kütz., which according to De Toni (131: 68), also led back to *Audouinella (Chantransia) saviana*. Such reasoning does not take account of the manner in which, for the above records, the names may have been employed in determination. See the further information under *A. saviana*.

Audouinella canariensis (Børgesen) Garbary ['*canariense*']
Canaries (218).
[As *Audouinella canariense* (Børgesen) Garbary]
Canaries (227).
[As *Acrochaetium canariense* Børgesen]
Canaries (68; 88; 375; 430A).
[As *Chromastrum canariense* (Børgesen) Stegenga & Mulder]
Canaries (536).

Note. Børgesen (68), describing this as a new species, considered it very similar to *Audouinella secundata* (q.v.). See also the notes to the entry on *A. humilis* (Rosenvinge) Garbary. For an explanation of the required epithet form '*canariensis*', see the entry for *A. gracilis*.

Audouinella codicola (Børgesen) Garbary
Canaries (13; 218; 227; 232B; 350).
Sierra Leone (350).

Note. The record from Sierra Leone in 350 is a repeat by Lawson & John of the data published by Aleem (30; see below); the later authors expressed considerable doubt as to the validity of Aleem's determination.

[As *Acrochaetium codicola* Børgesen]
Canaries (68; 88; 108; 111; 218; 375; 430A).
Sierra Leone (30).
[As *Acrochaetium codiculum* (sic!) Børgesen]
Canaries (392).
[As *Rhodochorton codicola* (Børgesen) Nakamura]
Canaries (412).

Note. Many authors have expressed their opinions as to how close this taxon lies to European material often given the name *Audouinella codii* (P. & H. Crouan) Garbary. Børgesen (1927: 33) so stated whilst actually describing *Acrochaetium codicola*. Levring (375) went so far as believing it not possible to separate the taxa. Cordeiro-Marino (108) and Cribb (111) generally supported this closeness of similarity, the former author adding *Acrochaetium phacelorhizum* Børgesen to the pattern. Cribb (111: 186) commented of *A. polyrhizum* (Harvey) J. Agardh, *A. grande* (Levring) De Toni, and *A. codicola* Børgesen: 'seems doubtful whether they can be kept separate.'

Audouinella codii (P. & H. Crouan) Garbary
[As *Acrochaetium codii* (Crouan) Bornet]
Canaries (191).
[As *Rhodothamniella codii* (Crouan) J. Feldmann]
Canaries (33; 375).
'Atlantique (de la France aux Canaries)' (33).

Note. See data presented in the entry for *A. codicola* (Børgesen) Garbary. *A. codii* may also be confused with *A. nemalionis* (De Notaris ex Dufour) Dixon in some reports – see the details given in Stegenga & Van Erp (1979).

Audouinella crassipes (Børgesen) Garbary
Canaries (227).

[As *Acrochaetium crassipes* Børgesen]
Canaries (39; 68; 71; 141B; 191; 375).
Salvage Islands (38B; 231; 375).
[As *Kylinia crassipes* (Børgesen) Kylin]
Canaries (108).
[As *Chromastrum crassipes* (Børgesen) Papenfuss]
Canaries (430A).

Note. When describing this taxon in 1927, Børgesen indicated that he had only one specimen, found on '*Acrochaetium codicola*'; he regarded the most nearly related species as *Acrochaetium catenulatum* Howe. Woelkerling (1971) suggested *Audouinella crassipes* possibly to be conspecific with *A. microscopica* (Nägeli) Woelkerling. Subsequently, in 1972 and 1973 (558: 86–88), Woelkerling included *Chantransia crassipes* Børgesen, *Acrochaetium crassipes* (Børgesen) Børgesen, *Kylinia crassipes* (Børgesen) Kylin, and *Chromastrum crassipes* (Børgesen) Papenfuss, all in the synonymy of *Audouinella microscopica* (Nägeli) Woelkerling. In this, he has been followed by Cribb (113: 14–15) and Schneider (512: 12–13). It is therefore probable that all the above records are really relevant only to *A. microscopica* (q.v.), but in the absence of definitive determination for all but the Børgesen records (68; 71), we have maintained the entry separately.

Audouinella cymopoliae (Børgesen) J. Price, **comb. nov.**
Basionym: *Acrochætium cymopoliæ* Børgesen in *Biol. Meddr* **6** (6): 22, fig. 12 (1927).
[As *Acrochaetium cymopoliae* Børgesen]
Canaries (68; 88; 227; 430A).

Note. The record in Gil-Rodriguez & Afonso-Carrillo (227) was reported with '?', presumably as to doubtful species determination. Woelkerling (1971) suggested that the taxon was possibly conspecific with a number of others, so that the above combination in *Audouinella* has been made for convenience only, pending further clarification on synonymy. For additional detailed data on life-history and morphology, see Stegenga & Borsje (1976).

Audouinella dasyae (Collins) Woelkerling
Bioko (350).
Gambia (296; 350).
Ghana (288; 299; 350; 376).
Liberia (129; 288; 350).

Note. Audouinella dasyae is probably a gametophyte generation of *A. saviana* (Meneghini) Woelkerling, *A. hypneae* (Børgesen) G. W. Lawson & D. John, or *A. bispora* (Børgesen) Garbary, or possibly of all of them. For further data, see Schneider (512) and, a fuller treatment, Stegenga & Borsje (1976). The latter authors indicated considerable possible 'synonymy' with many other 'species'. See Stegenga & Van Erp (1979) for placement within their system of groups in *Acrochaetium*.

Audouinella daviesii (Dillwyn) Woelkerling
Canaries (172; 227; 288).
Côte d'Ivoire (288; 350).
Gabon (294; 350).
Liberia (129; 288; 350).
Sierra Leone (350).
'virtually cosmopolitan' (172).
[As *Acrochaetium daviesii* (Dillwyn) Nägeli]
Canaries (39; 68; 191; 372; 373).
'North Atlantic to the Canaries' (372; 373).
[As *Acrochaetium daviesi* (Dillwyn) Nageli (sic!)]
Sierra Leone (30).
[As *Acrochaetium Daviesse* (Dillwyn) Nägeli]
Canaries (490).
[As *Acrochaetium daviessii* (Dillwyn) Nägeli]
Canaries (489).

Note. Since Børgesen (68) noted some differences from Rosenvinge's Danish material, he presented a fresh description of the taxon. *A. daviesii sensu* Rosenvinge agrees with Stegenga & Van Erp's (1979) group III within *Acrochaetium* (the group confusingly named *A. daviesii*) although Stegenga & Van Erp actually placed *A. daviesii* in their group II (group name *A. nemalionis*, q.v.). Some parts of the descriptions presented by Woelkerling (1973) and by Dixon (in Dixon & Irvine, 172) would lie in group III of Stegenga & Van Erp.

Audouinella densa (Drew) Garbary
See *Audouinella microscopica* (Nägeli) Woelkerling.

Audouinella endozoica (Darbishire) Dixon
Ghana (350).

Note. This name was tentatively applied by Lawson & John, to small plants growing on *Codium guineense*, following comments by Woelkerling (pers. comm.) on difficulties in determination. These plants were sterile and the chloroplast structure could not certainly be distinguished.

Audouinella gracilis (Børgesen) Jaasund [*'gracile'*]
[As *Audouinella gracilis* (Børgesen) Garbary]
Canaries (227).
[As *Acrochaetium gracile* Børgesen]
Canaries (68; 71; 191; 218; 430A; 490).

Note. Garbary (218: 490), apparently overlooking that Jaasund (280: 415) had already recombined this epithet in *Audouinella*, remade the combination in 1979 – hence the citation form of the record in Gil-Rodriguez & Afonso-Carrillo (227). *Audouinella*, as a feminine first declension noun, would require the form '*gracilis*' in its adjective, not the form '*gracile*' as used by Jaasund, which form is neuter. In this respect, Garbary was more accurate than Jaasund, but this does not invalidate the earlier combination.

Audouinella hallandica (Kylin) Woelkerling
Sierra Leone (350).
Togo (350).
'widespread in warm temperate and tropical seas' (350).
[As *Acrochaetium sargassi* Børgesen]
Sierra Leone (30).
[As *Acrochaetium* sp.]
Togo (293).

Note. This is not the same taxon as *Audouinella hallandica sensu* Kapraun (1980: 41). Woelkerling (558: 82–85) firmly established the recombination of *Chantransia hallandica* Kylin in *Audouinella*. The epithet had previously been subject to recombination in *Acrochaetium* (Hamel, 246: 20); *Chromastrum* (Papenfuss, 1945: 321); *Kylinia* (Kylin, 1944: 13, 15); and *Rhodochorton* (Rosenvinge, 1935: 7). There seems to be no good reason why Garbary (218: 490) should have re-made the combination in the course of his listing (Appendix I) of the required changes in nomenclature amongst *Audouinella* spp. referred to in the body of his paper.

Synonymy attributed here is also based on Woelkerling (1973: 84); he commented (p. 85) that Børgesen (1915: 19) expressed doubt as to real distinctions between his own *Acrochaetium sargassi* and the *Chantransia dufourii* of Collins (1911: 187), although Taylor (540: 302) subsequently attempted to maintain the taxa on the basis of slight differences in cell width and basal cell size. Critical comparisons of type material of these and of *A. (Ch.) hallandica* failed to establish any firm distinctions. See also the note for Togo material of *Audouinella* sp. For additional life-history data, consult Stegenga & Borsje (1977). Woelkerling (pers. comm.) held the opinion that *Audouinella parvula* (Kylin) Dixon (q.v.) was probably a small form of the present taxon.

Audouinella humilis (Rosenvinge) Garbary
[As *Colaconema humilis* (Rosenvinge) Woelkerling]
Western Sahara (349).

Note. Børgesen (68: 21) commented that his *Acrochaetium canariense* (see *Audouinella canariensis*) seemed to show an especial likeness to *Chantransia humilis* Rosenvinge and to *Chantransia polyblasta* Rosenvinge. Stegenga & Mulder (536: 300) suggested that material that would be considered as of *Audouinella (Acrochaetium) humilis* (as *Chromastrum humile* (Rosenvinge) Papenfuss) or of *Audouinella (Acrochaetium) polyblasta* (as *Chromastrum polyblastum* (Rosenvinge) Papenfuss) might be the best solution in identifying the tetrasporophyte of their *Chromastrum moniliforme* (Rosenvinge) Papenfuss [which was included by Woelkerling (1972) in the synonymy of *Audouinella microscopica* (q.v.)]. Since they had previously (Stegenga & Borsje, 1977) for convenience used the name *C. polyblastum* (Rosenvinge) Papenfuss for the sporophyte of *Audouinella hallandica* (*Chromastrum hallandicum* (Kylin) Papenfuss), the same reasoning was applied in utilisation of *Chromastrum humile* (Rosenvinge) Papenfuss by Stegenga & Mulder (536) in connection with the gametophyte *Audouinella humilis*.

Audouinella hypneae (Børgesen) G. W. Lawson & D. John
Namibia (36B).
Sierra Leone (30; 350).

Note. The original record established by Aleem (30) has been considered doubtful by Lawson & John (350), in view of previous known (western Atlantic only) distribution. Schneider (512) also presented data on distribution whilst re-making, apparently having overlooked the existing 1982 publication, the combination in *Audouinella* (512: 11). According to Schneider (pp. 5 and 11), *Audouinella seriata* (Børgesen) Garbary is strictly a synonym of *A. hypneae*, but we have currently maintained separate entries for both taxa; some doubt on conspecificity remains and the nomenclatural position of *A. seriata* is complex, making it simpler to explain the situation by separate presentations.

Audouinella hypneae may possibly represent an alternate phase of *A. dasyeae* (q.v.), and some authors (Schneider, 512: 11; Hall & Eiseman, 1981) doubt the practicability of distinguishing between *A. hypneae* and *A. saviana* (q.v.) on the suggested spore-size basis.

Audouinella macropoda (P. Dangeard) J. Price, **comb. nov.**
Basionym: *Acrochaetium macropoda* P. Dangeard in *Botaniste* **36**: 265, pl. XVII fig. A, 1–4 (1952).
[As *Acrochaetium macropoda* (?) P. Dangeard]
Sénégal (122).

Audouinella microscopica (Nägeli) Woelkerling
Ghana (350).
Nigeria (346; 347; 350).

Note. Woelkerling (1972) reduced seven acrochaetioid species to synonymy of *Audouinella microscopica*. Of the names encountered thus far in material from the present area, only *Acrochaetium crassipes* Børgesen (*Audouinella crassipes* (Børgesen) Garbary) is affected. See the note to the latter entry; it is strongly likely that these taxa *are* conspecific but, for reasons explained under *A. crassipes*, we maintain separate entries for now. Stegenga & Vroman (1976) suggested *A. microscopica* as possibly a gametophytic generation of *A. densa* (Drew) Garbary, provided that seriate monosporangia were considered taxonomically unimportant at species level. Schneider (512: 9) considered such sporangia as taxonomically important, pending further study. Stegenga & Mulder (536) did not agree with Woelkerling's (1972) earlier findings; in their opinions, *A. microscopica* should be considered as a *Chromastrum*, with at least three of the suggested seven synonyms being based on material sufficiently distinct to stand (at specific or subspecific levels) as separate taxa. They consulted in this study material said to be 'Type', in Leiden. See also the note to *Audouinella humilis* (Rosenvinge) Garbary.

Audouinella moniliformis (Rosenvinge) Garbary
See the entry for *Audouinella humilis* (Rosenvinge) Garbary.

Audouinella naumannii (Askenasy) J. Price, **comb. nov.**
Basionym: *Chantranisia Naumannii* Askenasy, *Forschungsreise Gazelle, Bot., Alg.*: 31, taf. VIII fig. 13–14 (1888).
[As *Acrochaetium naumannii* (Askenasy) Bornet]
Cape Verde Islands (246).
[As *Acrochaetium naumannii* Askenasy]
Cape Verde Islands (38; 66).
[As *Chantranisia* (sic!) *Naumannii* Askenasy]
Cape Verde Islands (37).
[As *Chantransia naumani* (sic!) Askenasy]
Cape Verde Islands (450; 451).
[As *Chantransia Naumanni* (sic!) Askenasy]
Cape Verde Islands (131; 139).

Note. Askenasy (37; 38), who dealt with the Naumann ('*Gazelle*') collections, appears to be the real primary source of all the above records.

Audouinella nemalionis (De Notaris ex Dufour) Dixon
Canaries (172).
[As *Acrochaetium nemalionis* (De Notaris ex Dufour) Bornet]
Canaries (68; 547).
Cape Verde Islands (37).
[As *Acrochaetium nemalionis* (De Notaris) Bornet]
Canaries (68; 191; 246; 430A).
'Atlantique (du Danemark aux Canaries)' (488).

Note. Woelkerling (1971) and later (588: 88–89) suggested that several other taxa have features strongly in common with *Audouinella nemalionis*. The relationships of the latter with *Audouinella thuretii* (Bornet) Woelkerling and with *Acrochaetium avrainvilleae* Børgesen, inter alia, as examples, needed clarification through examination of types and other collections. He continued: 'The major difference between *A. Nemalionis* and the Sargasso Sea specimens of *Audouinella thuretii* is apparently the lack of a funiform prostrate system in the latter, and this difference is of dubious taxonomic value'. Stegenga & Van Erp (1979) retained the group name *Acrochaetium nemalionis* for their group II within that genus and many European records would fall within that group; some, however, (e.g. that of Rosenvinge, 1909) would accord on description better with group I, to which the name *Acrochaetium zosterae* Papenfuss was applied. The same authors suggested implication of *A. nemalionis* with *A. saviana*, at species rather than group level, but only on morphological group grounds (and in the concept of Rosenvinge, so far as *A. saviana* was concerned). Nevertheless, De Toni (131: 68) had in 1897 included *Callithamnion Nemalionis* De Notaris in the synonymy outlined in his entry for *Chantransia Saviana* (Meneghini) Ardissone [= *Audouinella saviana* (Meneghini) Woelkerling, 1973].

Audouinella occidentalis (Børgesen) Garbary
Canaries (227).
[As *Acrochaetium occidentale* Børgesen]
Canaries (71; 191; 375; 430A).
[As *Acrochaetium occidentale* var. *occidentale*]
Canaries (218).
[As *Acrochaetium occidentale* var. *caespitosa* Børgesen]
Canaries (68; 88).

Audouinella parvula (Kylin) Dixon in Parke & Dixon
Cameroun (350).
Canaries (172; 227).
'from boreal-antiboreal to tropical parts of the Atlantic' (350).
[As *Acrochaetium parvulum* (Kylin) Hoyt]
Canaries (68; 191; 218; 375).
[As *Chromastrum parvulum* (Kylin) Papenfuss]
Canaries (430A).

Note. Woelkerling (pers. comm. to D. M. John) commented (see 350): 'this species is possibly no more than a small form of *Audouinella hallandica*'. See also Abdel-Rahman (1984).

Audouinella polyblasta (Rosenvinge) J. Price, **comb. nov.**
Basionym: *Chantransia polyblasta* Rosenvinge in *K. dansk. Vidensk. Selsk. Skr.* VII, **7** (1): 115, fig. 43 (1909).

Note. This combination, seemingly never previously made, is effected here for rationalisation only. See the note to *Audouinella humilis* – there may be close relationships with *A. canariensis, A. microscopia, A. hallandica*, amongst others. Previous references involved recombinations as *Acrochaetium polyblastum* (Rosenvinge) Børgesen (Stegenga & Borsje, 1977) and *Chromastrum polyblastum* (Rosenvinge) Papenfuss (Stegenga & Mulder, 536).

Audouinella purpurea (Lightfoot) Woelkerling
Mauritanie (349).
'Norway to Mauretania' (172).
[As *Byssus purpurea* Lamouroux]
Canaries (90).

Note. Recorded in 349 directly on the basis of the Dixon & Irvine statement (172). Lawson & John (349:

113) did not draw attention to the fact that the distribution statement in 172 could also include Western Sahara.

Audouinella cf. **repens** (Børgesen) Woelkerling
Salvage Islands (38B).

Note. Audiffred & Weisscher (38B: 29) commented that: 'Because of the above mentioned differences [primarily dimensional, or of spore-persistence], the identification of our plants cannot be quite satisfying.'

Audouinella sargassi (Børgesen) Garbary

Note. See the entry for *Audouinella hallandica* (Kylin) Woelkerling; for a further record with possible relevance, see the Togo report listed under *Audouinella* sp.

Audouinella saviana (Meneghini) Woelkerling
Cameroun (350).
Gabon (350).
[As *Audouinella saviana* (Montagne) Woelkerling]
Gabon (294).
[As *Acrochaetium molle* (Pilger) Hamel]
Cameroun (247; 430A).
[As *Chantransia mollis* Pilger]
Cameroun (139; 454).
[As *Chantransia saviana* Ardissone]
Canaries (547).

Note. Pilger (454: 299) had at the outset recognised the proximity of his *Chantransia mollis* with *Chantransia saviana*, in stating: 'Die neue Art ist verwandt mit *Callithamnion (Chantransia) byssaceum* Kütz. (nach De Toni = *Chantransia saviana* (Menegh.) Ardiss., einer mir nicht bekannten Art).' See also the notes to *Audouinella seriata*, for further data on close relationships. Relevant information also appears under *A. dasyae* (a possible alternate generation) and (as regards *A. saviana sensu* Rosenvinge) under *A. nemalionis*.

The spore-size distinction previously often utilized in differentiating between *Audouinella saviana* and *A. hypneae* (q.v.) may be at best rendered difficult by a recent report (Hall & Eiseman, 1981) of larger spore dimensions than is usual in *A. seriatum* (q.v.). The latter taxon was placed by Schneider (512: 11–12) in synonymy with *A. hypneae*, on the grounds that the understood distinctions between those taxa in respect of basal system characteristics were unreliable.

Audouinella secundata (Lyngbye) Dixon
Canaries (172; 512).
Mauritanie (349).
'North Norway to Mauretania' (172).
[As *Colaconema secundata* (Lyngbye) Woelkerling]
Canaries (558).
[As *Audouinella virgatula* (Harvey) Dixon]
Canaries (172; 227).
Mauritanie (349).
Salvage Islands (38B).
'Northern Norway to Mauretania' (172).
[As *Audouinella virgatulum*]
Canaries (306B).
[As *Acrochaetium virgatulum* (Harvey) Bornet]
Canaries (16; 68; 191; 556).
Salvage Islands (556; 556A).
[As *Acrochaetium virgatulum* (Harvey in Hooker) J. Agardh]
Canaries (392).
[As *Chromastrum virgatulum* (Harvey) Papenfuss]
Canaries (430A).

Note. Proliferation of the basal system in older plants may obscure earlier clear distinctions and lead to confusion of *Audouinella secundata* with *A. dasyae* and/or *A. saviana* (q.v.). Essentially similar relationship problems arise with *Audouinella (Acrochaetium) canariensis* Børgesen; when describing the new species, Børgesen considered it similar to *A. secundata* but to show different development of the basal disc.

The Mauritanie record in Lawson & John (349) is based solely on the distributional statement in Dixon & Irvine (172). The basis for citation of the southern limit of distribution as Mauritanie in 172 is not clear. Lawson & John made no reference to the fact that the overall statement could also include Western (Spanish) Sahara. This applies to the blocks of records by the names of both the accepted *Audouinella secundata* and the synonymized *Audouinella virgatula*.

Synonymy of this taxon shows the usual *Audouinella* (*Acrochaetium*, etc.) extreme complexity. Woelkerling (1971: 52) considered that *A. virgatula* (Harvey) Dixon and *Colaconema tenuissima* (Collins) Woelkerling might be no more than two forms of a single variable species. Later (558: 94–96), he firmly placed *Callithamnion virgatulum* Harvey in Hooker [= *Chantransia virgatula* (Harvey) Thuret in Le Jolis; *Acrochaetium virgatulum* (Harvey) Bornet; *Chromastrum virgatulum* (Harvey) Papenfuss; *Rhodochorton virgatulum* (Harvey) Rosenvinge; *Trentepohlia virgatula* (Harvey) Farlow] in synonymy with *Audouinella secundata* (Lyngbye) Dixon [*Colaconema secundata* (Lyngbye) Woelkerling]. He correctly observed that some authors had maintained these species as separate (e.g. Dixon & Irvine, 1977; Kornmann & Sahling, 1978) on the basis of differences in number of layers in the prostrate system and slight differences in height, branching, or cell size. Others (e.g. Rosenvinge, 1909; Woelkerling, 558 and 1973; Cribb, 1983; Schneider, 1983), by contrast, rejected these distinctions, considering that variation was too great to permit reliable species limits to be drawn. The latter view is accepted here.

Audouinella seriata (Børgesen) Garbary
Gabon (350).
Gambia (350).
Nigeria (350).
'Warm temperate and tropical parts of the Atlantic Ocean' (350).
[As *Audouinella seriatum* (Børgesen) G. W. Lawson & D. John]
Mauritanie (349).
Nigeria (346; 347).
[As *Acrochaetium seriatum* Børgesen]
Gabon (294; 350).
Gambia (296).
Mauritanie (349).
[As *Acrochaetium* sp.]
Gabon (294).

Note. The recombination of this epithet in *Audouinella* was in fact first carried out in print by two of us (DMJ; GWL; 349: 113), but, although citing the basionym, this omitted to present necessary reference data. Garbary (218: 490), remaking the combination in *Audouinella*, probably in ignorance of the previous attempt, gave full citation of the basionym reference data and his recombination must therefore stand; Lawson & John did not rationalise the situation for their recombination until 1982. In the earlier publication, furthermore, the previous combination in *Acrochaetium* was elsewhere (349: 105, stn 4) textually so left. Lawson & John (350) indicated that their Gabon material differed in minor respects from description and illustration of the type, and the determination was therefore presented with some doubt; the material was the same as that earlier reported (294) as *Acrochaetium* sp.

There is conflicting opinion about the conspecificity of the present taxon with other apparently related taxa. *Audouinella seriata* was considered by Lawson & John (350) to show close resemblance to *A. saviana* (q.v.) both as to basal system and, often, stalked monosporangia arising in series; minor variations of frequency and sporangial dimensions occurred. Cribb (1983: 16), judging from the literature, concluded that *A. seriata* and *A. saviana* were likely to be conspecific. By contrast to this, Schneider (512: 5) considered *A. seriata* and *A. hypneae* to be conspecific, the latter epithet deriving from earlier (1909) work by Børgesen than did the former (1915). Since resolution of these conflicting opinions was not possible here, we have maintained separate entries for each of the three taxa involved.

Audouinella streblocladiae (P. Dangeard) J. Price, **comb. nov.**
Basionym: *Acrochaetium streblocladiae* P. Dangeard in *Botaniste* **36**: 265 (1952).
[As *Acrochaetium streblocladiae* P. Dangeard]
Sénégal (122).

Audouinella thuretii (Bornet) Woelkerling
See the notes at *Audouinella nemalionis* (De Notaris ex Dufour) Dixon.

Audouinella virgatula (Harvey) Dixon
See *Audouinella secundata* (Lyngbye) Dixon.

Audouinella spp.
Ghana (376; 377; 491).
Liberia (129).
Salvage Islands (38B).
[As *Acrochaetium* sp.]
Gabon (294).
Sénégal (59; 529).
Togo (293).

Note. Plants from Liberia (129) were all sterile, despite densely developed but sparingly branched forms being available. Material reported from Gabon was stated to be closely allied to *Audouinella (Acrochaetium) seriatum*. Specimens from Togo were apparently (John & Lawson, 293) of close resemblance to *Acrochaetium dufourii* (Collins) Børgesen and *Audouinella sargassi* (q.v.), both of which are often synonymized with *Audouinella hallandica* (Kylin) Woelkerling, in recent years. *A. sargassi* has a very distinctive thick-walled basal cell, whilst *A. dufourii* has non-tapering filaments lacking hairs and with sparsely-developed branching.

Ballia prieurii Kützing
Ghana (unpublished).

Note. Strictly from freshwater, submerged on the leaves of *Saxicoliella amicorum* (Podostemaceae) on boulders in rapids, in the Ankasa River in SW. Ghana (Hall, 1971). Included here on the grounds of the primarily marine Ceramiacean genus to which the material apparently belongs. Determined by H. Skuja (in litt., to J. B. Hall, Ghana, 15 April 1970) as follows (translation from the German): 'In so far as the few, somewhat sparingly present, denuded axial parts of shoots provide evidence, the alga seems to be a species of the genus *Ballia*, most probably *B. Prieurii* Kütz. *Ballia* spp. are in nature really marine plants, although one finds some of them frequently to occasionally as intrusives into the lower parts of rivers . . . thus form[ing] part of a special biological grouping of secondarily freshwater reds'. See, for additional detail, Hall (1971) and Skuja (1944).

Bindera insignis J. Agardh
See *Spyridia insignis* (J. Agardh) J. Agardh.

Boergeseniella

Note. A Kylin segregate genus from *Polysiphonia*, recognised and used in some parts of the world, especially France. See the entry for *Polysiphonia fruticulosa* (Wulfen) Sprengel.

Bonnemaisonia hamifera Hariot
Canaries (227; 392).
'tetrasporangial phase [*Trailliella*] from Denmark to the Canary Islands' (172).
[As *Trailliella intricata* Batters]
Canaries (71; 191; 392).

Note. *Trailliella intricata* is well-known as the tetrasporophyte of *Bonnemaisonia hamifera*. Meñez & Mathieson (392: 34) recorded the alga as 'Trailliella intricata' only, although they indicated the life-history relationship. Feldmann (191: 404) commented: 'Sans doute d'importation récente'.

Bornetia secundiflora (J. Agardh) Thuret
Canaries (227; 228).
Ghana (292; 299; 350; 376).
Guinea-Bissau (529).
Sénégal (59; 292; 529).
'widespread from boreal-antiboreal to tropical seas' (350).
[As *Griffithsia secundiflora* J. Agardh]
'In mari . . . atlantico ad oras . . . Africae' (318).

Boryna compacta Bory in Duperrey

Note. For Ascension records, see *Ceramium compactum* (Bory) J. Price.

Bostrychia

The validity of records established within the list area for many species in this genus is quite difficult to resolve with any certainty. A significant proportion of the difficulty arises from conflicting statements, confusing nomenclature, and somewhat inscrutable German texts published over periods of many years. Some degree of arbitrary re-allocation, based on those cases where sufficient data exist for reasoned conclusion, has been required in various instances; this will be found mostly to account for differences of attribution between previous literature and the present list. To a rather lesser degree, the same reasoning may be applied in entries for *Catenella, Caloglossa*, and *Murrayella*.

Bostrychia binderi Harvey
Angola (101; 352; 458; 535).
Bioko (350).
Cameroun (108; 337; 347A; 350; 458; 460; 467; 535).
Gabon (294; 347A; 350).
Ghana (338; 342; 347A; 350; 458; 460; 461; 462; 463; 464; 467; 473; 535; 537).
Guinée (347A; 350; 460; 535).
Liberia (129; 347A; 350).
Mauritanie (349).
Nigeria (347A; 350).
São Tomé (93; 347A; 350; 470; 473; 535).
?Senegambia (133; 296).
Sierra Leone (295; 339; 347A; 350; 374; 460; 464; 468; 535).
'Kamerun an südwärts' (460).
'tropical and subtropical Atlantic' (535).
'West Africa' (347B).
'widespread in warm temperate and tropical seas' (350).
[As *Bostrychia pilifera* Kützing]
Ghana (unpublished).
Senegambia (133; 323; 410; 460).
Sénégal (458).

Note. Attribution here is on the basis of the opinions of both De Toni (133: 1163, 1166–67) and Post (in litt., to Steentoft); for full details of the former's statements, see the terminal note. The Ghanaian record represents an herbarium specimen, the nomenclature of which was corrected before the subsequent publication in Lawson (342).

[As *Bostrychia tenella* (Vahl) J. Agardh]
Ghana (153, p.p. with *B. tenella*; see 535).
Sierra Leone (336).

Note. The Mauritanie record in Lawson & John (349) was based on only a single fragment entangled with *Enteromorpha*. De Toni (133: 1163, 1166–67) attributed the Senegambia record of *Bostrychia pilifera* Kützing originally to *B. tenella* (Vahl) J. Agardh in the following terms: '*Bostrychia pilifera* Kuetz. . . . e Senegambia ad *Bostrychiam tenellam* valde accedit. Hujus nullam authenticum specimen vidi.' Later, under *Bostrychia Binderi* Harvey, he added: 'An huc *Bostrychia pilifera* Kuetz. ex Senegambia ??'. Confusion has often arisen between the taxa *B. binderi* and *B. tenella*. The name '*B. binderi* f. *terrestre* (Harvey) Post' was based on Harvey material from the Friendly Islands; Harvey, omitting to provide a description, called the plant *B. terrestre*. J. Agardh first described the Harvey no. 22 as *B. tenella* var. *terrestris*; later, he raised it to specific rank as *B. terrestris*. Finally, De Toni (139) reduced *B. terrestris* to the synonymy of *B. tenella. B. binderi* f. *terrestre* is therefore attributed here to *Bostrychia tenella* (q.v.).

Bostrychia calliptera (Montagne) Montagne
Côte d'Ivoire (287; 288; 347A; 350).
Ghana (288; 342; 344; 347A; 350; 467; 468).
Guinée (347A; 350; 458; 460; 461; 464; 467; 468; 513).
Nigeria (347A; 350).
Sierra Leone (295; 347A; 350; 468; 473).

'an der Guineaküste von Kamerun bis Französisch-Guinea bestens bekannt' (468).
'probably widespread in tropical seas' (350).

Note. Post (467: 70) erroneously commented: 'Neu ist *Bostrychia calliptera* für . . . die Goldküste'. The *collection* by Lawson was new, but he had by then already published the record (342). Schnell (513) perpetrated the same error in recording the taxon as new for Africa in 1950. Regarding the species in Nigeria, Lawson & John (350) indicated that some plants found in the Niger Delta have the morphology of this species but the cortication does not appear clearly rhizoidal; subsequent collections by J. M. Baker, Field Studies Council, from various stations in the Delta nevertheless strongly suggest that the taxon is indeed present and possibly of common occurrence.

Bostrychia hookeri Harvey
See *Bostrychia mixta* Hooker f. & Harvey.

Bostrychia mixta Hooker f. & Harvey
[As *Bostrychia hookeri* Harvey]
Ascension (unpublished).

Note. These BM herbarium records are based on undated specimens from an unknown collector, possibly from the early 1900s. For other possibly additional records from Angola of *Bostrychia mixta* and *Bostrychia radicans*, based on *Welwitsch* 59 and published as *B. tenella* by Barton (41: 373), see the notes to *B. tenella* (Vahl) J. Agardh. The presence of *B. mixta* on South Atlantic island or mainland coasts would not be surprising; it has otherwise been reported from south Chile, Tierra del Fuego (including Hermite Island), Gough Island, Tristan da Cunha, Nightingale Is., South Africa, southern Australia, Kyushu (Japan), and New Zealand.

Bostrychia montagnei Harvey
Sierra Leone (295; 347A; 350; 526).
'probably widespread in warm temperate and tropical parts of the Atlantic Ocean' (350).
[As *Bostrychia scorpioides* (Hudson) Montagne var. *montagnei*]
Sierra Leone (468; 473).

Note. Post (468) does not make it absolutely clear (although there is some implication that it *was*) whether or not 'typical' *Bostrychia scorpioides* was present alongside the variety *montagnei* Harvey. The latter is now considered a synonym of *B. montagnei* Harvey (see Sluiman, 1979). In 1968, Post (473) reported the data earlier given in 468, this time without ambiguity, as the variety only is referred to. Sluiman (526) noted its distribution as a species as: 'roughly restricted to tropical Atlantic region determined by 18°C isotherms of coldest months in both hemispheres'; see Sluiman (526) for additional detail.

Bostrychia moritziana (Sonder ex Kützing) J. Agardh
Cameroun (347A; 350; 458; 459; 465).
Congo (220A).
Gabon (220A).
Gambia (296; 347A; 350).
Ghana (350).
Liberia (129; 347A; 350).
Namibia (467).
Nigeria (347A; 350; 459; 465).
São Tomé (347A; 350; 467).
Sierra Leone (347A; 350).
'Westafrika' (466).
'widespread in warm temperate and tropical seas' (350).
[As *Bostrychia moritziana* Agardh]
Cameroun (458).

Note. Several of the quoted records for certain areas are included here for distributional completeness only, since they represent collections from freshwater conditions. This is the case with those from Ghana (350), Namibia (467), and Nigeria (350); other species of *Bostrychia* also penetrate low-salinity waters – see, for example, the entry for *B. radicans*. The Post (467) report from São Tomé, although referring to a record made as *B. moritziana*, actually represents *Bostrychia radicans* f. *depauperata* (q.v.); the report was based on Thorold collection, no. 611.

Records from Cameroun here are not surprising; the indication of reference 458 (Post, 1936) as a source does, however, require some explanation. There (p. 79), Post stated: 'Anderseits ist d. Bostr. «periclados» von Bidundi [= Bibundi]-Kamerun (J. Ag. in Nordstedt, 1897, S. 171 & Lund Nr. 34.216–17, leg. R. Jungner; = *B. Mor.*) von *Murrayella* auszuschliessen.' This is the origin of citation of 458 which, for cross-referencing completeness, is also mentioned in *Bostrychia* spp. and *Murrayella periclados* terminal notes.

For comments on the Gabon and Congo freshwater records in 220A, see Post's (467: 49) opinion outlined in the notes to *Bostrychia radicans*.

Bostrychia 'periclados'
See the notes at entries for *Bostrychia moritziana, Bostrychia* spp., and *Murrayella periclados*.

Bostrychia pilifera Kützing
See *Bostrychia binderi* Harvey.

Bostrychia pilulifera Montagne
Sénégal (296).
Senegambia (296).

Bostrychia radicans (Montagne) Montagne
Bioko (350; unpublished).
Cameroun (139; 288; 337; 350; 454; 458; 460; 462; 463; 465; 467; 468; 500; 535; 537).
Congo (220A; 473; 535).
Côte d'Ivoire (347A; 465).
Gabon (220A; 294; 347A; 350; 465; 471; 473; 535).
Ghana (288; 342; 344; 347A; 350; 465; 467; 535).
Guinée (347A; 350; 384; 460; 464; 465; 467; 468; 535; 560).
Liberia (347A; 350; 468).
Nigeria (288; 347A; 350; 458; 465; 467; 535).
St Helena (465).
São Tomé (288; 347A; 350; 465; 467; 473; 535).
Sierra Leone (30; 295; 336; 339; 344; 347A; 350; 374; 378; 460; 464; 465; 467; 468; 473; 535).
'West Africa' (269; 290; 566).
'Westafrika' (466).
'an der Guineaküste von Kamerun bis Französisch-Guinea bestens bekannt' (468).
'Probably pantropical' (535).
'probably widespread in warm temperate seas and pantropical' (350).
'von Französisch-Guinea bis Kamerun bekannte' (467).
'von Frz. Guinea bis Kamerun (einschl. Sao Thomé) ohne Berücksichtigung der weit südlich gelegenen St Helena Bay- sind 27 litorale Bostrychia radicans-Standorte bekannt' (465).
[As *Bostrychia radicans* f. *depauperata* Montagne]
Cameroun (350; 458; 468).
Gabon (465; 473).
Guinée (468).
São Tomé (350; 467; 470).
Sierra Leone (350; 468).
'an der Guineaküste von Kamerun bis Französisch-Guinea bestens bekannt' (468).
[As *Bostrychia radicans* f. *hapteromanica* Post]
Cameroun (288; 350; 458).
Côte d'Ivoire (287; 288; 350; 465).
[As *Bostrychia radicans* f. *moniliforme* Post]
Cameroun (108; 350; 458; 468).
Ghana (342; 350; 465; 467).
Guinée (350; 460; 468; 513).
Nigeria (unpublished).
Sierra Leone (468).

'an der Guineaküste von Kamerun bis Französisch-Guinea bestens bekannt' (468).
[As *Bostrychia radicans* f. *radicans*]
Cameroun (108).
Nigeria (108).
Sierra Leone (108).
[As *Bostrychia radicans* f. *typica*]
Cameroun (460).
Ghana (342; 467).
Guinée (460; 461).
Nigeria (213; 467).
São Tomé (470).
Sierra Leone (468).
'an der Guineaküste von Kamerun bis Französisch-Guinea vestens bekannt' (468).
[As *Bostrychia simpliciuscula* Harvey ex J. Agardh]
Ghana (344; 460; 461; 462; 464; 465).
Nigeria (213; 347A).
[As *Bostrychia tenuis* f. *simpliciuscula*]
Nigeria (467).
[As *Polysiphonia letestui* P. Dangeard]
Gabon (116A; 471; 473).

Note. Except where otherwise indicated, all records relate (so stated or not) to *Bostrychia radicans* f. *radicans*. Where the authority had been given simply as 'Montagne', no distinction has been drawn between that form and the correct author-citation.

This species is not uncommonly reported from freshwater or from low salinity habitats. In cases of equivocal phraseology, when 'marine' conditions may also have been involved, or where other interest required it, such records are indicated above (e.g. Congo, 473; Gabon, f. *depauperata*, 465, 473); otherwise, inland records are omitted. Gauthier-Lièvre & Schotter (220A) recorded a freshwater *Bostrychia* from Congo/Gabon; this was subject to comment by Post (467: 49), who concluded that it could have involved both *B. radicans* and *B. moritziana*. In relation to the Gabon records, also from freshwater conditions, under the name *Polysiphonia letestui* in Dangeard (116A), Post (471: 150) appears to have been stating that the equating by Dangeard (116A; 32) of his *'Polysiphonia' letestui* with Montagne's *'Polysiphonia' spinescens* from the brackish waters of Guyana must be in error since the former taxon belongs to *Bostrychia radicans*, whilst the latter taxon she (Post, 458: 79) had already established as a synonym of *Murrayella periclados* (q.v.).

The unpublished Nigeria record of f. *moniliforme* Post relates to material so attributable detected amongst recent collections by Dr J. M. Baker, Field Studies Council, from the Ramus River area of the Niger Delta.

Further unfortunate complication was introduced unnecessarily by Post (458 and 467: 49, 60) into the already complex overall situation. Based on reports involving misdetermination by Fox (213), Post (467) recorded what we deduce to be *B. radicans* from Nigeria, this under the name *B. tenuis* f. *simpliciuscula*. Fox herself (213: 626) had employed the name *Bostrychia simpliciuscula* in recording the alga initially in 1955. Later she (Fox, as Steentoft, 1967, reference 535) referred to her previous report and correctly placed the alga under the name *Bostrychia radicans*. An earlier treatment (458) by Post of similar material from South Africa had already been dismissed by Papenfuss (1943, on *B. simpliciuscula*) on grounds of inadequacy of procedure. Post (467: 66) subsequently (1963), immediately beneath her main species heading for this forma, stated quite unequivocally albeit contradictorily 'Nicht Nigerien'!

For possible additional records of *B. radicans* and *B. mixta* from Angola, based on Welwitsch 59 and published by Barton (41: 373) as *B. tenella*, see the notes to *B. tenella* and *B. mixta*. For comments on the São Tomé record of f. *depauperata* in Post (467), see the notes to *Bostrychia moritziana*.

Bostrychia scorpioides (Hudson) Montagne
[As *Bostrychia scorpioides* (S. Gmelin) Montagne]
Sierra Leone (468; 472).
'an der Guineaküste von Kamerun bis Französisch-Guinea bestens bekannt' (468).
[As *Bostrychia scorpioides* var. *montagnei*]
Sierra Leone (468; 472).

Note. For an analysis of some aspects of the distribution of *Bostrychia scorpioides* see Sluiman (1978).

See the notes to *Bostrychia montagnei* in regard to validity and probable attribution of the records as var. *montagnei*, above.

The record of the parent species in Post (468: 301) is based on collections by F. J. Taylor from the Sierra Leone mangrove facies west of Freetown, on the left bank of Aberdeen Creek, SW. of Aberdeen Point. She (Post) commented on this as: 'das erstmalig *Bostrychia scorpioides* für Westafrika enthält.' In the same work, she later (468: 304) added: 'Neu ist *Bostrychia scorpioides* für Westafrika (Guineaküste bei Freetown bei 8 1/2° nördlicher Breite)'. In view of the descriptive phrase from 468, quoted above, for the distribution, it is decidedly odd that none of the countries trending westward along the northern Gulf of Guinea coast between Cameroun and Sierra Leone receives separate citation of extant records.

Bostrychia simpliciuscula Harvey ex J. Agardh
See *Bostrychia radicans* (Montagne) Montagne.

Bostrychia tenella (Vahl) J. Agardh
Angola (41; 352).
Bioko (350).
Cameroun (337; 347A; 350; 454; 458; 460; 467; 537).
Ghana (153p.p.; 338; 342; 347A; 350; 460; 463; 467; 472; 473; 537).
Guinée (347A; 350; 460).
Sénégal (458; 460).
Senegambia (454; 460).
Sierra Leone (30; 336; 347A; 350; 464).
'African West Coast' (374).
'all warmer seas' (336).
'West Africa' (347B).
'widely distributed in all warmer seas' (62).
'widespread in tropical and subtropical waters' (280).
'widespread in warm temperate and tropical seas' (350).
[As *Bostrychia tenella* Agardh]
Angola (458).
Cameroun (458).
Ghana (463).
[As *Bostrychia tenella* J. Agardh]
Angola (41; 42).
[As *Bostrychia binderi* f. *terrestre*]
Ghana (342; 350; 467).
[As *Bostrychia pilifera* Kützing]
Senegambia (133; 323; 535).
'Warm Atlantic' (41).

Note. The Ghanaian record in Dickinson & Foote (153) proved pro parte to be of *Bostrychia tenella* (Vahl) J. Agardh and pro parte of *B. binderi* Harvey (q.v.).

See Lawson & John (350) for reasoning relating to the attribution here of various records named as *B. binderi* f. *terrestre*; the essentials of the reasoning are also presented in the note to *B. binderi* (q.v.) here.

De Toni (133: 1163, 1167) appears to have been in some doubt as to the attribution of *B. pilifera* records; initially allocating them to *B. tenella*, he immediately afterwards suggested that they represented a form of *B. binderi*. Post (in litt. to Steentoft, cf. 535) held the former of these contrasting views.

Lawson (347A: 61) stated: 'It [*B. tenella*] has not to date been positively identified in Nigeria but is likely to be present as it is very closely related to *B. binderi* and is often found occurring together with it.'

Bostrychia tenuis Post and f. **simpliciuscula**
See *Bostrychia radicans* (Montagne) Montagne.

Bostrychia spp.
Angola (298; 347A; 500).
Cameroun (337; 344; 458; 500; 533).
Ghana (42A; 220; 287; 338; 344; 487; 491; 537).
Guinée (344; 384; 529; 537).
Nigeria (347A).

Sénégal (467).
Sierra Leone (31; 287; 339; 344; 466; 537).
Western Sahara [Rio de Oro] (467).
'West Africa' (290; 345; 347A).

Note. For details of the possible attribution of Cameroun records in Post (458), see the notes to *Bostrychia moritziana* (especially) and *Murrayella periclados*.

Botryocarpa prolifera Greville
Namibia (348; 522).

Note. The record in Lawson & Isaac (348) is based directly on information from Simons (522).

Botryocladia

Many taxa in this genus are almost entirely, often deeply, subtidal in occurrence. As such, they are less consistently and representatively collected than would be desirable for full appreciation of other than local area taxonomy. Ephemerality of appearance is an added problem, especially as regards those 'species' that colonize rhodoliths or other mobile surfaces on the seabed. Many of the morphological criteria that are used to differentiate between subgeneric taxa relate to the vegetative state and seem to vary with plant age and characteristics of local ambience, hence being unsatisfactory as distinguishing factors. Poor representational material and essentially time-limited collections for examination have tended both to cause neglect of the reproductive state, since rarely detected, as a basis for taxonomy, and to lead to proliferation of names for plants from different geographical areas, without any real attempts to study the genus over any sufficiently wide area for rationalization. The same factors have also led to misapplications of those names that have been reported from widespread areas to material eventually recognised (from the few attempts to broaden study) not to be of the same taxa. Hence, many of the names and records that follow require critical re-evaluation in the light of a wider understanding of the genus. A recent attempt at such wider understanding for the western tropical Atlantic (Puerto Rico; Caribbean) has been presented by Ballantine (159); this should be consulted since it exemplifies many of the problems outlined above.

Botryocladia boergesenii J. Feldmann
Salvage Islands (38B; 556; 556A).

Note. The relationship between material reported under this name, as *Botryocladia pyriformis* (Børgesen) Kylin, as *Botryocladia* sp., and as other taxa reported from the Canary Islands, urgently requires clarification.

Botryocladia botryoides (Wulfen) J. Feldmann
Cameroun (292; 350).
Canaries (38B; 38C; 128A; 189; 191; 229; 292; 351; 375; 401; 489; 517; 547).
Cape Verde Islands (292).
Congo (292).
Gabon (294; 350).
Ghana (292; 299; 350; 376; 377).
Salvage Islands (38B; 38C; 337).
Sénégal (292).
'West Africa . . . Gulf of Guinea' (286).
'West Africa' (289).
'Atlantic Ocean (from Cadiz to Canary Islands).' (177).
'Atlántico cálido (de Cadiz a Canarias)' (517).
'Atlantique chaud (de Cadix aux Canaries)' (189).
'in warm temperate and tropical parts of the eastern Atlantic Ocean' (350).
[As *Bothryocladia bothryoides* (Wulfen) Feldmann]
Canaries (227; 229; 232B).
[As *Botryocladia occidentalis* (Børgesen) Kylin]
Canaries (97; 232B).
[As *Botryocladia uvaria* (Wülfen) Kylin]
Canaries (328).

[As *Chrysymenia uvaria* (L.) J. Agardh]
Cameroun (454).
Canaries (64; 69; 70; 132; 337; 439; 499; 547).
Cape Verde Islands (41; 42).
Salvage Islands (215; 216; 336).
'Nordwestafrika' (499).
'Westafrika' (499).
'In ganzen wärmeren Atlantischen Ozean' (499).
'warmer parts of Atlantic Ocean' (72).
[As *Chrysymenia uvaria* (Wulfen) J. Agardh]
Congo (249; 250).
Gabon (249; 250).
'De Cadix aux Canaries' (89).
[As *Chrysymenia (Botryocladia) uvaria* (Wulfen) J. Agardh]
'in oceane Atlantico calidiore' (24).
[As *Chondria uvaria* (Wulfen) C. Agardh]
'In mari Atlantico . . . ad Teneriffam' (19).
[As *Gastroclonium Uvaria* (Wulfen) Kützing]
'in mari . . . atlantico calidiori' (318).
[As *Gastroclonium uvaria* Kützing β *macrococcum* Kützing]
Canaries (318).
[As *Gastroclonium Uvaria* Kützing forma *macrococca canariensis*]
Canaries (323).
[As *Lomentaria Uvaria* (Wulfen) Duby]
Canaries (401).
[As *Lomentaria Uvaria* Duby]
Canaries (44).
[As *Ulva ulvoides* Bory]
Canaries (90).
[As *Fucus uvarius* L.]
Canaries (90).

Note. For details of distinctions between *Botryocladia botryoides* and *B. pyriformis*, see the notes to the latter. Børgesen (69; 70) commented on similarities in vesicle size and gland cell size between materials from the Canaries and elsewhere, especially the var. *occidentalis* from the West Indies.

Reasons for the attribution here of *Ulva ulvoides* Bory are presented in the notes to the latter.

Chapman's (97) assumption of conspecificity between *Botryocladia botryoides* and *B. occidentalis* requires additional confirmation, although it is true that the material he named as *B. occidentalis* from the Canaries should correctly be referred to *B. botryoides*; the same applies to the report from the Canaries, erroneously stated to be the first for the island group under the name *B. occidentalis* (Børgesen) Kylin, by Gil-Rodriguez et al. (232B: 101, 103–104). Similarly, material determined variously as *B. uvaria*, although often correctly to be referred to *B. botryoides*, may conceal taxa (new or with existing names) more accurately placed elsewhere; we have not made a complete re-survey on other than nomenclatural grounds. It has been shown by Papenfuss (pers. comm. to Seagrief; see Seagrief, 1984) that the so-called *B. uvaria* from South Africa should all be named as *B. madagascariensis* G. Feldmann; this requires to be borne in mind as a possibility for at least the southern parts of the present area.

Botryocladia chiajeana (Meneghini) Kylin
Canaries (38D; 128A; 191; 224; 229; 232B; 375).
'West Africa' (286; 289).
'Atlantique (de la côte Basque aux Canaries)' (189).
[As *Chrysymenia [Chrysimenia] chiajeana* Meneghini]
Canaries (70; 184; 490).
Mauritanie (184).
[As *Chrysymenia ciajeana* (sic!) Meneghini]
Canaries (235).

[As *Bothryocladia* (sic!) *chiajeana* (Meneghini) Kylin]
Canaries (227; 229; 379).

Botryocladia fernandeziana Levring
See *Botryocladia lawsonii* D. John.

Botryocladia guineensis D. John
Ghana (286; 290; 299; 300; 350; 376).
'West Africa' (289).
'tropical parts of the eastern Atlantic Ocean' (350).

Note. See John (286) for full details of relationships; most closely resembles *B. skottsbergii* (Børgesen) Levring.

Botryocladia hancockii Dawson
See *Botryocladia senegalensis* G. Feldmann & Bodard.

Botryocladia lawsonii D. John
Ghana (289; 350).
'tropical West Africa' (350).
'tropical eastern Atlantic' (159).
[As *Botryocladia* sp.]
Ghana (299; 376).

Note. See John (289) for full details of relationships; most closely resembles *Botryocladia papenfussiana* Ganesan & Lemus and *B. fernandeziana* Levring (both from the Pacific). See also the comments in Ballantine (159).

Botryocladia madagascariensis G. Feldmann
See *Botryocladia botryoides* (Wulfen) J. Feldmann

Botryocladia occidentalis (Børgesen) Kylin
See *Botryocladia botryoides* (Wulfen) J. Feldmann

Botryocladia papenfussiana Ganesan & Lemus
See *Botryocladia lawsonii* D. John.

Botryocladia pyriformis (Børgesen) Kylin
Canaries (13; 226; 306B).
[As *Bothrocladia* (sic!) *pyriformis* (Børgesen) Kylin]
Canaries (227).

Note. Gil-Rodriguez & Afonso-Carrillo (226) indicated a close relationship with *Botryocladia botryoides*, save in the elongated vesicles of *B. pyriformis* and in the different distribution of secretory cells. They commented that this was the first report from the Canaries of a species 'propria de las costas tropicales americanas'. See also comments in Ballantine (159).

Botryocladia senegalensis G. Feldmann & Bodard
Sénégal (55; 59; 182; 272A; 290).
'West Africa' (286; 289).
'tropical eastern Atlantic' (159).
[As *Bothryocladia* (sic!) *senegalensis* G. Feldmann & Bodard]
Sénégal (56; 59).

Note. G. Feldmann & Bodard (182) also indicated records for the small coastwise island of Gorée [Gorea], Sénégal. They suggested fairly close relationship with *Botryocladia hancockii* Dawson, from the Gulf of California; both these taxa are anatomically very similar to *Chrysymenia enteromorpha* Harvey. See also comments in Ballantine (159).

Botryocladia skottsbergii (Børgesen) Levring
See *Botryocladia guineensis* D. John.

Botryocladia uvaria (Wulfen) Kylin [or (L.) Kylin]
See *Botryocladia botryoides* (Wulfen) J. Feldmann.

Botryocladia spp.
Canaries (226).
Ghana (376; 487).

Note. The record in Round (487) is based directly on previous works by Lawson & John (various dates). As such, the purely generic reference must relate to a combination of the species *Botryocladia botryoides, B. guineensis*, and *B. lawsonii*.

Botryoglossum platycarpum (Turner) Kützing
Namibia (348; 522; 523).

Note. This alga, well-known from South Africa, is a not particularly surprising southern element in the Namibian marine flora. All the records stem from Simons's finds north to Lüderitzbucht (Elizabeth Bay); Simons himself (523) expressed the distribution pattern as 'Lüderitz to Danger Point . . . becomes abundant in Namaqualand.'

Brachycladia australis Sonder
See *Galaxaura marginata* (Ellis & Solander) Lamouroux.

Brachycladia marginata (Solander) Schmitz
See *Galaxaura marginata* (Ellis & Solander) Lamouroux.

Brachytrichia maculans

Note. Records established in Lawson (337) under this name for Cameroun were repeated in Stephenson & Stephenson (537). Although it could be quite reasonably supposed that the material concerned represented *Galaxaura*, with which the generic name *Brachytrichia* is commonly associated, this is not the case; the species involved was a blue-green alga, *Calothrix crustacea* Bornet & Flahault.

Brachytrichia marginata (Solander) Schmitz
See *Galaxaura marginata* (Ellis & Solander) Lamouroux.

Brongniartella mucronata (Harvey) Schmitz
Sénégal (55; 59).
'Atlantique tropicale' (59).

Note. Parsons (1980) considered that *Brongniartella* at present consists of *B. byssoides* (Europe; type species) and *B. australis* (southern Australia; New Zealand) only. The status of the present taxon and its relationship to *Brongniartella* therefore need critical study.

Bryocladia cuspidata (J. Agardh) De Toni
Cameroun (350; 454; 484).
Gambia (296; 350).
Liberia (129; 350).
'tropical parts of the Atlantic Ocean' (350).

Bryocladia thyrsigera (J. Agardh) Schmitz
Angola (298; 352).
Cape Verde Islands (411).
Côte d'Ivoire (287; 288; 290; 350; 394).
Gambia (350).
Ghana (42A; 153; 213; 285; 288; 338; 344; 350; 537).
Guinea-Bissau (529).
Liberia (287; 288; 350).
Nigeria (213; 288; 344; 350; 488A; 537).
Sénégal (47; 52; 55; 59; 122; 184; 186; 213; 344; 399; 411; 529; 537; 542).
Senegambia (133).
Sierra Leone (350).
Togo (288; 293; 350).
'Atlantique tropicale' (59; 529).
'côtes de l'Afrique tropicale, par J. Agardh' (542).
'warm temperate and tropical parts of the Atlantic Ocean' (350).

[As *Bryocladia thyrsigera* (C. Agardh) Schmitz]
Angola (352).
Gambia (296).
Liberia (129).
Sierra Leone (295).
[As *Polysiphonia thyrsigera* J. Agardh]
Senegambia (26).

Bryothamnion lindenbergii Kützing
See *Bryothamnion seaforthii* (Turner) Kützing.

Note. Falkenberg (179: 176) implied strongly (but did not definitively state) the equivalence of the taxa *B. seaforthii* and *B. lindenbergii* in stating: 'Unter dem mir zur Verfügung gestellten Material, welches Professor Greeff auf der Insel Rolas im Golf von Guinea gesammelt hatte, fand sich eine durchaus mit *B. Seaforthii* identische Pflanze, die ich andererseits nach Abbildung und Beschreibung für die afrikanische *B. Lindenbergii* Kützing's halten muss.'

De Toni (133: 975) very soon (1903) after made a definite statement of reduction of *B. lindenbergii* to synonymy of *B. seaforthii* (q.v.), which we have followed.

Bryothamnion seaforthii (Turner) Kützing
Angola (535).
Guinée (62; 97; 350).
São Tomé (133; 179; 251; 263; 264; 265; 350; 535).
'an eadem species in sinu Guinea ad ins. "Rolas"?' (133).
'does not extend from Gulf of Guinea into Senegal' (487).
'in Oceano Atlantico ad oras Africae' (139).
'? Pantropical' (535).
'probably widespread in tropical seas' (350).
'welches Professor Greeff auf der Insel Rolas im Golfe von Guinea gesammelt hatte' (179).
[As *Bryothamnion Lindenbergii* Kützing]
Angola (26; 316; 318; 323).
[As *Bryothamnion seaforthii* Kützing]
São Tomé (251; 263; 264).

Note. The definitive statement of synonymy of *Bryothamnion seaforthii* and *B. lindenbergii* is presented in De Toni; details are given in the cross-reference to *B. lindenbergii* (q.v.). The first to suggest, without effecting, the reduction to synonymy was Falkenberg (179: 176); details appear at *B. lindenbergii*.

Chapman (97) may well have been referring to Guiana [Guyana], not Guinée (West Africa), since all other records in 97 relate to countries bordering the western, not the eastern, Atlantic.

Bryothamnion triangulare ['**Bryothamnium**'] *auct.*
See *Bryothamnion triquetrum* (S. Gmelin) Howe.

Bryothamnion triquetrum (S. Gmelin) Howe ['*Bryothamnium*']
Angola (535).
Cape Verde Islands (191; 500; 535).
São Tomé (93; 350; 535).
'Atlantic coast of Africa' (62; 97).
'in Oceano Atlantico ad oras Africae (Kuetzing, Greeff)' (139).
'? Pantropical' (535).
'Probably widespread in tropical seas' (350).
[As *Bryothamnion triangulare* (Gmelin) Kützing (or (L.) Kützing)]
São Tomé (133; 179; 251).
'Ad oras tropicas Africae et Americae' (318).
'ex oris occidentalibus Africae (Kuetzing); ad insulam "Rolas" in sinu Guineae (Greeff)' (103).
'coste occidentali dall'Africa' (390).
'kommt auch an der Westküste von Afrika vor wo Profesor Greeff sie auf Guinea sammelte' (179).
[As *Bryothamnion triangulare* (J. Agardh) J. Agardh]
Cape Verde Islands (38).

[As *Bryothamnion triangulare* (Gaud.) Kützing (or simply Kützing)]
São Tomé (263; 264; 265).
'Ad oras tropicas Africae' (263; 264).
[As *Alsidium triangulare* J. Agardh]
Cape Verde Islands (528; 551).
[As *Alsidium triangulare* (L.) J. Agardh]
Cape Verde Islands (408).
[As *Physcophora triangularis* (Turner) Kützing]
Angola (316).
'Golf von Guinea, an der Küste Angola' (316).

Note. The exact wording of the record immediately above (in Kützing, 316) has been reproduced as, Angola not being strictly in the Gulf of Guinea, the São Tomé (Rolas) record may also be comprehended.

Byssus purpurea Lamouroux (or Lightfoot)
See *Audouinella purpurea* (Lightfoot) Woelkerling.

Calliblepharis ciliata (Hudson) Kützing
Mauritanie (252; 349).
'Atlantique: depuis les côtes anglaises jusqu'en Mauritanie' (222).
'British Isles to Mauretania' (172).

Note. Dangeard twice indicated (117; 118) that this alga was missing from the Canaries. Nevertheless, the general statements of distribution would imply the likelihood of material occurring in appropriate conditions and seasons in at least Western (Spanish) Sahara.

Calliblepharis jubata (Goodenough & Woodward) Kützing
Mauritanie (349).
'Atlantique (de l'Angleterre à la Mauritanie)' (33).
'British Isles to Mauretania' (172).
[As *Calliblepharis jubata* Kützing]
'Atlantique, depuis les côtes anglaises jusqu'en Mauritanie' (222).

Note. Lawson & John (349) were recording only secondarily from Mauritanie. Dangeard twice (117; 118) indicated this alga to be missing from the Canaries. See also the comment at *Calliblepharis ciliata*.

Callithamniella tingitana (Schousboe ex Bornet) Feldmann-Mazoyer
Ghana (288; 512A).
Liberia (129; 288).
[As *Grallatoria tingitana* (Schousboe ex Bornet) Abbott]
Ghana (350; 376; 377).
'in warm temperate and tropical seas' (350).

Note. Schneider (512A: 459) advanced reasons why he was hesitant to follow Abbott's (1976) grouping of *Callithamniella tingitana, flexilis,* and *capensis* into *Grallatoria*, without further information. Additionally, he noted certain differences between specimens described by Abbott (1976), Feldmann-Mazoyer (196), Joly (1965), and Simons (521), and those he encountered in North Carolina. More recently, Wynne & Ballantine (1985) argued cogently that *Grallatoria* Howe and *Callithamniella* Feldmann-Mazoyer are *not* congeneric, thus confirming, albeit from different bases, Schneider's (1984) reservations. Wynne & Ballantine (1985: 224–225) distinguished the two genera on tetrasporangial division (cruciate – *Callithamniella*; tetrahedral – *Grallatoria*), on branching pattern of laterals on indeterminate axes (singly or in pairs in irregular sequence in *C. tingitana*, whorl-branches in pairs or in threes in precise alternating sequence in *G. reptans*), on differences in rhizoids that arise from the basal cell of laterals/whorl-branches (unicellular, mostly, in *C. tingitana*; multicellular in *G. reptans*).

Callithamnion and allied genera
The status of previous area records of genera such as *Aglaothamnion, Callithamnion, Compsothamnion, Pleonosporium,* and *Seirospora* requires critical re-examination based on herbarium, laboratory, and field studies in the various locations concerned. This overall pattern of work is in progress, but requires much more time than permissible during the production of the present work. The records under entries for species in the above genera therefore represent a combination of previously established literature information and entirely new determinations

based on examination of recent field material. Much of the latter still remains to be studied. Except in special cases, extant herbarium material or field-pressed specimens have not been completely scanned during the work.

Only in those cases where recent reports of taxa present are established or accepted here, and parallel or confirm the previously published data, can it be taken that these latter are reasonably well-founded for the area. A preliminary move has been made in the direction of applying long-established species names from the northern hemisphere to present area material that, if detected growing in that northern hemisphere, would generally have been regarded as unequivocal.

Callithamnion byssoides Arnott ex Harvey in W. Hooker
Canaries (227; 232B; 253; 306B).
'Atlántico (Noruega – Canaries . . .)' (253).
'Eastern Atlantic from western Norway to Canaries and Morocco' (172A).
[As *Callithamnion byssoides* Arnott in Hooker]
Canaries (392).
'Atlantic coast of Europe & N. Africa' (61; 71; 97).
[As *Callithamnion byssoides* Arnott]
Canaries (38D; 71; 191; 375).
Sierra Leone (30).
[As *Callithamnion byssoides* (Arnott) var. *arachnoideum*]
Canaries (547).
[As *Aglaothamnion furcellariae* (J. Agardh) G. Feldmann]
Salvage Islands (38B).
'Atlantic from Denmark to the Canaries' (97).
'Atlantique, de la Scandinavie aux Canaries' (190).
'Atlantique (de la Scandinavie au Maroc, Canaries . . .)' (33).
[As *Aglaothamnion furcellariae* (J. Agardh) Feldmann-Mazoyer]
Canaries (556; 556A; 557).
Salvage Islands (556; 556A; 557).

Note. See the note to *C. tenuissimum* (Bonnemaison) Kützing and data presented by Price (in Lawson & John, 350) for detailed comments on difficulties with these taxa in the present area. The comments are especially important as regards the Sierra Leone and Canaries records; Aleem's (30) record is the only one for mainland western Africa.

The attribution of records here is in many cases based only on the nomenclatural equivalence of the combinations used by the publishing authors. No morphological revision has been attempted of material forming the bases of the records (even where extant) and consistency in application of names cannot therefore be guaranteed throughout for previous studies.

Callithamnion corymbosum (J. E. Smith) Lyngbye
Canaries (38B; 38D; 97; 128A; 191; 214; 232B; 239; 253; 375; 379; 555; 556).
Salvage Islands (38B; 38D; 555; 556; 556A).
'Atlántico (Noruega – Canarias . . .)' (253).
'Atlantic from Denmark to the Canaries' (97).
'Atlantique (. . . Canaries . . .)' (33).
'Atlantique, du Danemark aux Canaries' (190; 196).
'Eastern Atlantic, Norway (Nordland) to Canaries' (172A).
[As *Callithamnion corymbossum* (sic!) (Sm.) Lyngbye]
Canaries (227).
[As *Callithamnion corymbosum* Lyngbye]
Canaries (547).
[As *Callithamnion corymbosum* (Engl. Bot.) Lyngbye]
Canaries (71; 191).
[As *Ceramium fruticulosum* Bonnemaison]
Sénégal (Casamance) (99).

Note. Since it is the only mainland record (Sénégal) for the entire area, that in Chevalier (99) requires critical re-examination, although there is no fundamental reason to disregard it. Vickers's (547) report was based on only a single dredged specimen and represents by a long period the earliest traced for the Canaries. Few specimens are normally detected together in the list area. See Dixon & Price (172A) for background comment.

Callithamnion decompositum J. Agardh
Mauritanie (349).
'Eastern Atlantic from the Faeroes to Sénégal' (172A).
[As *Callithamnion decompositum* (Grateloup) J. Agardh]
Angola (298; 352).
Mauritanie (349).
[As *Aglaothamnion decompositum* (Grateloup ex J. Agardh) Halos]
Mauritanie (245A; 245B).
Sénégal (55; 59).

Note. Irregularly recorded, but probably more widespread and frequent than is implied by the literature. The report in Lawson & John (349) is based wholly on Halos (245A; 245B). Price (in Lawson & John, 350) indicated that since the species has been recorded from areas to north and south of the present region (Mauritanie, Sénégal, Angola), it could well eventually be found in cool-upwelling parts of the western Ghanaian coast, or on deeper subtidal rock reefs off Ghana. Halos (245A; 245B) considered that although distinct from it, *Callithamnion decompositum* lay near to *C. tripinnatum*; both are taxa of which the biological/morphological limits and overall validity require much more investigation and confirmation. See Dixon & Price (172A) for additional data.

Callithamnion ellipticum Montagne
Canaries (24; 27; 44; 71; 133; 191; 227; 401; 407; 483).
[As *Callithamnion ellipticum* Montagne var. *major* Crouan]
Canaries (410).
[As *Callithamnion* sp.]
Cape Verde Islands (483).
[As *Phlebothamnion ellipticum* (Montagne) Kützing]
Canaries (318; 320).

Note. Montagne (401: 177) commented at some length on what he then regarded as the affinities of his taxon. Amongst those affinities is that suggested with *Callithamnion spongiosum* Harvey ['. . . elle a beaucoup de caractères communs avec le *C. spongiosum* . . .']. Such a superficial relationship in morphology is certainly supported by the illustration presented in Kützing (320: Tab. 12c/d), which is imprecise but resembles a slightly modified *Callithamnion granulatum* plant. The precise limits and relationships of the taxon, and the past variations in application of the name, require further clarification. For notes regarding attribution here of the Cape Verde Islands record in Reinbold (483), see the entry for *Callithamnion* spp.

Callithamnion furcellariae J. Agardh
See *Callithamnion byssoides* Arnott ex Harvey in W. Hooker.

Callithamnion gallicum Nägeli
Canaries (71; 191; 227; 547).
[As *Aglaothamnion gallicum* (Nägeli) Halos]
'Atlantique . . . (. . . Canaries)' (33).

Note. The significance of this name and its reality as indicating a good taxon are unclear. Further complications exist through the variations in application of the name, amongst which those detailed here are of importance for the present area.

For general comments on the status of some of the Canaries and area records, see Price in Lawson & John (350) and Dixon & Price (172A). Note also the entry to *Callithamnion roseum*, to which the record published for Gabon in John & Lawson (294), as *C. gallicum*, is now referred. Doubt as to determination has, in any event, often been a characteristic of published references for both taxon and area, as for instance in numbers 191 and 547. The record established by Børgesen (71) for the Canaries, as *Callithamnion tetragonum*, may be based on material lying within this present same form-range, given that samples (e.g. K in BM) reflect homogeneity of name-application over the whole range of Børgesen specimens. Judging from the Nägeli (1862) illustrations associated with the original description of *C.*

[Maschalosporium] gallicum, even the concept itself may actually be based on material to which the name *Callithamnion brodiaei* would hitherto have been applied; Nägeli's taxon is based on Crouan frères' specimens originally so named by them (*Florule Finistère*, no. 154). The *C. brodiaei* concept actually lies within the form-range of *Callithamnion hookeri* (q.v.), of which the specimen in Leiden (940. 237. 136) from near Las Palmas [A. Vickers, 2 March 1896] is remarkably reminiscent.

Callithamnion gorgoneum (Montagne) Bornet
See *Tiffaniella gorgonea* (Montagne) Doty & Menez.

Callithamnion granulatum (Ducluzeau) C. Agardh
Canaries (128A; 227).
Côte d'Ivoire (288; 350).
Ghana (288; 350).
Liberia (288; 350).
'Atlantique: de l'Angleterre aux Canaries . . . Afrique du Nord' (221).
'*Atlantique nord*, de l'Angleterre aux Canaries' (190; 196).
'North-eastern Alantic from Shetlands to Morocco, perhaps to the Gulf of Guinea, locally (Liberia, Côte d'Ivoire, Ghana)' (172A).
'North Eastern Atlantic, Shetland to Ghana' (350).
'N. de Inglaterra hasta Canarias' (546).
[As *Callithamnion granulatum* Ducluzeau]
Liberia (129).
Mauritanie (349).

Note. For general background, including an assessment of morphological variations and similarities between northern hemisphere and Gulf of Guinea populations, see Price in Lawson & John (350). The present distribution requires further critical analysis. The Gulf of Guinea populations are found only in very restricted locations of fairly strong wave-run over rocky areas, exemplified by the situation in western Ghana. It is strange that there are so few reports of the species from the Canary Islands; the relative abundance and consistency of populations in similar conditions within the Mediterranean seems not to be repeated here.

Varo et al. (546) indicated for this taxon '= *C. spongiosum* Harv.'; this, not being true, is misleading, although local misapplication of names may understandably have led to this conclusion developing.

For comments on the record for Mauritanie in Lawson & John (349), see the entry for *Callithamnion* sp.

Callithamnion hookeri (Dillwyn) S. F. Gray
? Angola (267A; 350; 352).
Canary Islands (178A).
Ghana (267A; 350).
Namibia (36B).
'a disjunct population in the Gulf of Guinea in an upwelling area' (178B).
'Atlantic, Iceland and northern Norway to Canaries and Morocco' (350).
'between northern Norway and the Canary Islands and Morocco, occurring also . . . in areas of cold upwelling in the Gulf of Guinea (and perhaps sparsely in Angola)' (172A).
'in a cool upwelling area of the Gulf of Guinea' (267A).
'in areas of cold upwelling in Gulf of Guinea' (350).
'western tropical Africa' (36B).
[As *Aglaothamnion scopulorum* (C. Agardh) G. Feldmann]
'Atlantique (. . . Maroc, Canaries)' (33).
[As *Aglaothamnion scopulorum* (J. Agardh) G. Feldmann]
'Atlantique nord: de la Suède aux Canaries' (222).

Note. Material seems to be detected infrequently, perhaps due to ephemerality, in areas at the southern end of the range; for background, see Hoek (267A) and Price in Lawson & John (350). Similar areas outside the present area (e.g. Madeira; Levring, 375) seem to produce the same pattern. The Angola record is established with doubt since inadequate reproductive material was available for confirmation. Wynne's (36B) Namibia record was also doubtful, since based on a single small sterile specimen. Ardré (33: 174) indicated, under the name *Aglaothamnion hookeri*, that the species was to her knowledge unknown from south Portugal; she clearly accepted *A. scopulorum* and *A. hookeri* as separate species, in line with most continental usage. It is not possible adequately to support this view and her Canaries record for *A. scopulorum* therefore appears here. In both that case and the record published in Gayral (222: 525), it is not possible to confirm that the application of *A. scopulorum* was actually concerned with specimens of *C. hookeri*. There is no guarantee of homogeneity for the whole of the cited ranges, although Gayral's plate (CLV) without much doubt was of a specimen of *C. hookeri*. Most examples and reports of *A. [C.] scopulorum* prove to be so sensu Dixon & Price (172A) and Price (1978).

Callithamnion micropterum Montagne
See *Ptilothamnion pluma* (Dillwyn) Thuret in Le Jolis.

Callithamnion mildbraedii Pilger
Pagalu (139; 350; 456; 457; 496).

Note. Although Pilger's original comments (456: 11–13) included reference to *Callithamnion mildbraedii* as belonging to the group related to *C. fruticulosum* J. Agardh, it is doubtful if that can be supported. See Price in Lawson & John (350), especially the generic introduction to *Callithamnion*.

Callithamnion pluma (Dillwyn) C. Agardh [or simply C. Agardh]
See *Ptilothamnion pluma* (Dillwyn) Thuret in Le Jolis.

Callithamnion repens (Dillwyn) Lyngbye [or simply Lyngbye]
See *Spermothamnion repens* (Dillwyn) Rosenvinge.

Callithamnion roseum sensu Harvey
Cameroun (350).
Gabon (350).
Nigeria (unpublished).
[As *Callithamnion gallicum* Nägeli]
Gabon (294).
Ghana (unpublished).

Note. The Ghana record is based on material collected at Winneba; very like *Callithamnion gallicum* illustrations in some ways, and so determined originally, it is actually representative of a form within or near the form-range of *C. roseum* sensu Harvey. Identifications are similarly tentative for most of the other records, since only small amounts of material were available and reproductive structures were not generally found. An exception is the recent find by C. B. Powell (December 1985 – January 1986) from the mouth of the Bonny River, Nigeria; the material included both tetrasporangial and carposporophytic plants. For comments on the difficulties with this group of taxa in the area, see the note to *C. tenuissimum* (Bonnemaison) Kützing. For a fuller general background statement see the details given by Price in Lawson & John (350).

Callithamnion tenuissimum (Bonnemaison) Kützing
Ghana (350; 377).
Sierra Leone (?295; 350).

Note. John & Lawson's (295) expressed doubt as to determination concerned the sterile, mat-forming habit of the specimens detected. Problems with the other reports were similar, the small amounts of material all being dried on paper and in poor condition. Tentative determinations in these cases are based mainly on tetrasporangial characteristics; for a fuller statement, see Price in Lawson & John (350). The report of *Callithamnion byssoides* (q.v.) by Aleem (30) from Sierra Leone, with other previous records from the Canaries, are all likely to be based on forms of this same entity, whatever its real affinities.

Callithamnion tetragonum (Withering) S. F. Gray
Canaries (13; 128A; 226; 227; 306B; 375; 379).
'Recorded, possibly in error, from the Canaries, Cape Verde Islands, and the Cape of Good Hope' (172A).
[As *Callithamnion tetragonum* (Withering) C. Agardh]
Canaries (16; 24; 71; 108; 133; 191; 225; 392; 401; 441; 444; 517).
Cape Verde Islands (408).
Sénégal (408; 517).
'Atlantique (. . . Canaries)' (33).
'Atlantic coast of Europe southwards to the Canary Islands' (71).
'Atlántico desde Suecia a Canarias' (517).

'Atlantique nord, de la Suède aux Canaries' (190; 196).
[As *Callithamnion tetragonum* (Withering) J. Agardh]
Canaries (499).
Cape Verde Islands (499).
'Nordwestafrika' (499).
'Atlantischer ozean, südlich bis zum Kap der Guten Hoffnung' (499).
[As *Callithamnion tetragonum* (Dillwyn) C. Agardh]
Canaries (401).
[As *Callithamnion tetragonum* Agardh]
Canaries (44; 133; 390).
[As *Callithamnion tetragonum* J. Agardh]
Canaries (44).
Cape Verde Islands (38).
[As *Callithamnion tetragonum* Withering]
Canaries (24).
[As *Callithamnion tetragonum* Withering var. β = *C. brachiatum*]
Canaries (24).
[As *Callithamnion brachiatum* Harvey]
Canaries (493).
[As *Ceramium brachiatum* Bonnemaison]
Canaries (59A; 172A).

Note. The evidence for the presence of this taxon in the list area requires careful analysis; at the southern peripheries of the distribution ranges, it is quite possible that confusion with other entities such as *Aristothamnion collabens* (q.v.) has complicated the issue. See also comments in Dixon & Price (172A). At least some of the material reported by Børgesen (71) from the Canaries leaves some doubt as to conspecificity with the northern European taxon. Specimens seem nearer to the morphology referred to as *Callithamnion gallicum* (q.v.). Even the early Canaries report by Piccone (441; 444) was strongly qualified by the publishing author, the record being based on young material epiphytic on *Pterocladia capillacea*. Levring's (375) record from Funchal (Madeira), a single find, was on the same 'host'.

Callithamnion thuyoides J. Agardh
See *Compsothamnion thuyoides* (J. E. Smith) Schmitz.

Callithamnion tripinnatum C. Agardh
Sénégal (59).

Note. The nature and affinities of the material on which this taxon was originally based have not yet been fully clarified (see Dixon & Price, 172A). The specimens may possibly represent a form within the range of *Callithamnion hookeri* (q.v.). The epithet under which the record was established is maintained here since there exists the additional problem of the way in which the name was being applied by Bodard & Mollion (59).

Callithamnion spp.
Angola (352).
Cameroun (337; 344; 537).
Canaries (3; 214; 216; 439).
Cape Verde Islands (483).
Côte d'Ivoire (288).
Ghana (299; 376; 377; 491).
Guinée (288).
Mauritanie (349).
Salvage Islands (38B; 215; 216).
Sénégal (529).
[As *Aglaothamnion* sp.]
Guinée (344; 529).
Guinea-Bissau (529).

Note. The record for Cape Verde Islands in Reinbold (483) is repeated in the entry for *Callithamnion ellipticum* Montagne (q.v.), since Reinbold commented: 'Moglicherweise liegt *C. ellipticum* Mont.

(bekannt von der Kanarischen I.) vor.' The record in Lawson & John (349) for the west side of Cap Blanc (Mauritanie) is referred to as *Callithamnion granulatum* by Lawson & John and it is certainly close to that taxon; however, the morphology of specimens is rather odd and not completely alignable with the form from further north. The record is also referred to under *C. granulatum*. Piccone's (439) report from the Canaries was of small sterile specimens, the generic attribution of which was uncertain, although *Callithamnion* was suggested as most likely.

Callophyllis
The existence of this genus within the present list area requires a great deal more critical work before acceptance. Serious doubt of various kinds, principally either lack of conceptual clarity or inadequacy of collections available, attaches to all the following species records.

Callophyllis ? atro-sanguinea (Hooker f. & Harvey) Hariot
Sénégal (132; 141).

Note. The considerable doubt expressed by the use of '?' in the entry relates to the usual habitat and range of the taxon. The likelihood is not great that Southern Ocean, colder water forms, not apparently of great ecological tolerance, would reappear off the coast of Sénégal 'in sinu Gorée'. This, of course, pre-supposes accurate knowledge, understanding, and determination of the concept. The identity therefore requires confirmation.

Callophyllis fastigiata (J. Agardh) J. Agardh
Canaries (227).
[As *Callophyllis fastigiata* J. Agardh aff. *humilis, angusta*]
Canaries (70; 439).

Note. The initial record for the area, established by Piccone (439: 56), has been consistently questioned thereafter. Børgesen (1929: 75, reference 70) was the first to raise doubt, principally because the taxon was described from the Southern Ocean (Falkland Islands). Gil-Rodriguez & Afonso-Carrillo (227) firmly excluded the species from the accepted flora of the Canaries, although they commented on the record. In similar fashion, Papenfuss (1943: 85) excluded the species from the South African flora. The strong probability is that the taxon is both lacking in conceptual clarity and misdetermined for the area.

Callophyllis lecomtei Hariot
Congo (131; 249; 250; 350).

Note. All citing literature emphasises the similarities between the present species and *Callophyllis laciniata* (Hudson) Kützing. The differences presented by Hariot (249; 250) primarily concern the pinnate branching arrangement of *C. lecomtei*.

Callophyllis sp.
Ghana (299; 300; 376; 377).

Note. A sterile membranaceous red alga found at about 10m below low water, off the Ghanaian coast.

Callymenia
For combinations in or references to this genus, refer to entries under *Kallymenia* J. Agardh.

Callymenia dentata (Suhr) J. Agardh [or simply J. Agardh]
See *Anatheca montagnei* Schmitz.

Caloglossa leprieurii (Montagne) J. Agardh
Bioko (350).
Cameroun (288; 337; 350; 454; 462; 463; 467; 537).
Côte d'Ivoire (287; 288; 350).
Gabon (294; 350).
Ghana (153; 250; 287; 288; 342; 350; 462; 463; 467; 537).
Guinée (350; 460; 461; 462; 463; 464; 467).
Liberia (129; 350).
Nigeria (288; 347A; 350; 458; 460; 462; 467; 472).
St Helena (470).
São Tomé (350; 470).
Sénégal (296; 460).
Senegambia (458; 461).

Sierra Leone (30; 287; 295; 344; 350; 460; 461; 468; 473).
'an der Guineaküste von Kamerun bis Französisch-Guinea bestens bekannt' (468).
'Seems to be widely distributed in warmer seas' (63).
'von Franzosisch-Guinea bis Kamerun bekannte' (467).
'West Africa' (347B).
'widespread from boreal-antiboreal to tropical seas' (350).
[As *Caloglossa Leprieurii* J. Agardh]
'Throughout warm Atlantic' (410).
[As *Caloglossa Leprieurii* Montagne f. *typica*]
Cameroun (463).
[As *Caloglossa leprieurii* Montagne f. *continua* (Okamura) Post]
Guinée (461).
Nigeria (458).
[As *Caloglossa leprieurii* (Montagne) J. Agardh (or, simply, Montagne), var. *hookeri* Post (or (Harvey) Post)]
Cameroun (458; 460; 467; 537).
Ghana (460; 467; 468).
Guinée (384; ?458; 460; 464; 561A).
Nigeria (467).
Senegambia (458; 561A).
[As *Caloglossa mnioides* (Harvey) J. Agardh]
Guinée (?27).
[As *Caloglossa*]
Cameroun (500).

Note. Confusion exists as to typification of some part of the spectrum of names applied above, and hence as to the probable effects of the usage of those names. This is particularly complex in the case of the var. *hookeri*, which Post (458) described and illustrated on the basis of material previously made the type of *Caloglossa mnioides* J. Agardh (1876). West African plants appearing to fall within the confines of *C. mnioides* (= *C. leprieurii* var. *hookeri*) are retained here within the entry for the major species until the range of developmental morphological variation and phenotypic plasticity in different conditions are better understood. For similar reasons, f. *continua* (Okamura) Post, reported by the latter (461) from 'Dakar-Guinea', is not considered as requiring separate treatment at this time, pending rationalization. For the present area, all these problems are further complicated as to distributional significance by the precise meaning of the localisation 'Dakar-Guinea'. The country attributions as given in Lawson & John (350: 304) require some re-organisation. Post did not report (458: 51) *Caloglossa leprieurii* f. *continua* from 'Guinée' or from 'Dakar-Guinée', so that the entry for Guinée given in 350 and based on Post (458) should be discounted. However, she *did* so record and describe var. *hookeri* (Harvey) Post, based on the C. Agardh specimen no. 31.920 in Herb. Alg. Agardh, Lund, and named by C. Agardh *Delesseria opuntioides*. The significance of 'Dakar-Guinea' (Post 458: 55, 56) is not clear; in modern terms, it could have related to Sénégal (especially), Gambia, Guinea-Bissau, and Guinée. Although being non-committal on pp. 55 and 56, Post later (458: 59) gave some indication of her view of the meaning when, in the overall geographical distribution for the species *C. leprieurii*, she stated: 'Afrika: Senegambien: Dakar (*Del. opunt.*); Nigeria: Akassa; Kamerun: Bodje, Victoria, Campo;'.

We therefore take it, with some reservations, that the record for 'Dakar-Guinea' relates only to Sénégal and Gambia, as represented in the overall term 'Senegambia'. This may also be true for J. Agardh's (27: 500) record for 'Ad Guineam' as it is additionally for the careful re-statement by Wynne & Kraft (561A: 17) of Post's (458) data. For an analysis of morphological distinctions between the sometimes confused forms in the genera *Caloglossa* and *Hypoglossum*, see Wynne & Kraft (561A).

Caloglossa mnioides J. Agardh [or (Harvey) J. Agardh]
See the entry for *Caloglossa leprieurii* (Montagne) J. Agardh.

Caloglossa ogasawaraensis Okamura
Côte d'Ivoire (287; 288; 350; 464; 465; 467; 469; 470; 471).
Nigeria (347A; 350).
São Tomé (287; 288; 350; 464; 470; 473).
'probably pantropical' (350).

'West Africa' (347B).
Note. Post (470: 322) commented: 'Neu ist *Caloglossa ogasawarensis* für die Insel Sao Tomé'.

Caloglossa spp.
Angola (347A).
Ghana (344).
Nigeria (347A).
Sénégal (467).
Sierra Leone (31; 344; 466).
Western Sahara (467).
'West Africa' (290; 347A).

Campylaephora J. Agardh
See the entry for *Ceramium planum* Kützing.

Carpoblepharis flaccida (C. Agardh) Kützing
Namibia (128; 157; 348; 453; 522; 537).
Note. See Wynne (1985*c*) for a recent treatment of the background to *Carpoblepharis*.

Carpoblepharis minima Barton
Namibia (36B; 157).
Note. Dinter (157) based his report on his own collection from Walfischbai. Wynne's (36B) recent record was from south of Swakopmund. Since these are the only records for the list area, the relationship of the material to *Carpoblepharis flaccida* (C. Agardh) Kützing perhaps needs critical study, although Dinter did identify firmly both species as present. See Wynne (1985*c*) for recent data.

Carpoblepharis sp.
Namibia (348; 522).

Carpococcus perforatus (Bory) J. Agardh
Canaries (139).
[As *Fucus perforatus* Bory]
Canaries (19; 90).
[As *Gigartina pistillata* prox.; *G. perforata* (Bory) J. Agardh, nom. cons.]
Canaries (26).
Note. For additional background data, refer to the entry for *Laurencia perforata* Montagne. Many more recent studies, including the present list, have concluded that there is undoubted heterogeneity in the original Bory de St Vincent concept, borne out by the differential nature of his Fig. 1A as opposed to Figs 1B/1C. For an explanation of the situation, see De Toni (139: 229–230). The citation above of Bory's (90) original record from the Canaries is only in so far as concerns that part of the concept represented in description and illustration by Fig. 1A. The remainder of the original entry, exemplified in Figs 1B and 1C, is treated as a record of *Laurencia perforata* Montagne. Since C. Agardh (19) seems, from his terminal statement of 'Species Sphaer. [ococcus] mamilloso affinis', to have concerned himself only with the Fig. 1A concept, his secondary repeat is treated solely as a record of the present species.

Carradoria virgata (C. Agardh) Kylin
See *Tayloriella virgata* (C. Agardh) Papenfuss and *Polysiphonia virgata* (C. Agardh) Sprengel.

Catenella caespitosa (Withering) L. Irvine
Canaries (38D; 227).
Nigeria (347A; 350).
'West Africa' (347B).
'widespread from boreal-antiboreal to tropical seas' (350).
[As *Catenella opuntia* (Goodenough & Woodward) Greville]
Angola (458).
Ascension (458).
'Nordwestafrika' (499).

'Seems to occur in nearly all warmer seas' (63).
'Westafrika' (499).
[As *Catenella opuntia* Greville]
Angola (261; 262; 263).
Canaries (214).
[As *Catenella repens* (Lightfoot) Batters]
Canaries (229).
Liberia (129).

Note. Also reported from Madeira by Levring (375), but stated to be very rare since detected only twice. Material reported by De May et al. (129) from Liberia was tentatively referred to the present species since smaller and otherwise unlike the *Catenella impudica* (Montagne) J. Agardh (q.v.) from Côte d'Ivoire.

Catenella impudica (Montagne) J. Agardh
Cameroun (288; 350; 458; 460; 463).
Côte d'Ivoire (129; 287; 288; 350).
Guinée (350; 460; 461; 463; 464).
'West Africa' (347B).
'widespread from boreal-antiboreal to tropical seas.' (350).
[As *Catenella impudica* C. Agardh]
Guinée (513).
Sénégal (296; 463).
Senegambia (463).
[As *Lomentaria impudica* Montagne]
Sénégal (282).

Note. Post (468) commented on the situation of this species for Sierra Leone as follows: 'Die nicht angetroffene *Catenella* (*impudica*) dürfte etwas tiefe wachsen.' [The missing *C. impudica* ought to be growing somewhat deeper.]

Catenella opuntia (Goodenough & Woodward) Greville
See the entry for *Catenella caespitosa* (Withering) L. Irvine.

Catenella repens (Lightfoot) Batters
See *Catenella caespitosa* (Withering) L. Irvine.

Catenella sp.
Nigeria (347A).
'West Africa' (290).

Caulacanthus divaricatus (Suhr) Papenfuss
See *Caulacanthus ustulatus* (Turner) Kützing and *Caulacanthus* sp.

Caulacanthus fastigiatus Kützing
See *Caulacanthus ustulatus* (Turner) Kützing.

Caulacanthus notulatus (Martens) Kützing
See *Wurdemannia miniata* (Duby) J. Feldmann & Hamel.

Caulacanthus rigidus Kützing
See *Caulacanthus ustulatus* (Turner) Kützing.

Caulacanthus ustulatus (Turner) Kützing
Canaries (128A; 306B; 351; 567).
Cape Verde Islands (344).
Gambia (350).
Guinée (344).
Mauritanie (344).
Sénégal (344; 567).
Sénégal (Casamance) (290; 344; 350).
Sierra Leone (350).

Western Sahara (344).
'widespread in warm temperate and tropical seas' (350).
'Biarritz bis Senegal' (567).
[As *Caulacanthus ustulatus* (Mertens) Kützing (or, in parentheses, Mertens ex Turner)]
Angola (41; 298; 352; 500).
Canaries (3; 13; 227; 229; 230; 237; 375; 379; 482; 490; 499; 517; 546).
Cape Verde Islands (499).
Gambia (296; 529).
Guinea-Bissau (529).
Guinée (529).
Mauritanie (121; 349; 529).
Namibia (36B; 348; 515; 522).
Salvage Islands (38B; 231; 375).
Sénégal (50; 121; 122; 352; 408; 515).
Sénégal (Casamance) (529).
Western Sahara (529).
'Nordwestafrika' (499).
'Westafrika' (499).
'Atlántico (del Golfo de Gascuña al Senegal)' (517).
'Atlantique (de Biarritz au Sénégal)' (33).
'from Biarritz southward to Sénégal' (375).
'West African coast to the north of the Gulf of Guinea' (352).
[As *Caulacanthus ustulatus* Kützing]
Angola (41; 42).
Canaries (13; 16; 68; 191; 229; 318; 489; 499).
Cape Verde Islands (38; 41; 42; 191; 423).
Sierra Leone (30).
'Atlantique, du Golfe de Gascogne au Sénégal' (38).
'Atlantischer Ozean: Von der französischen Küste bis nach Westafrika und den Kanaren' (499).
'Du golfe de Gascogne au Sénégal' (89).
'Gulf of Gascogne down to Sénégal' (68).
[As *Caulacanthus ustulatus* (Mertens) Kützing var. *fastigiatus* (Kützing) Pilger]
Pagalu (139; 456; 457).
[As *Caulacanthus divaricatus* (Suhr) Papenfuss]
'Luderitz [Namibia] to Cape Vidal (Zululand)' (523).
[As *Caulacanthus fastigiatus* Kützing]
Canaries (385).
[As *Caulacanthus rigidus* Kützing]
Cape Verde Islands (38; 66; 145; 214).
Sénégal (38; 66; 139; 145; 214; 326; 515).
'northwest Africa' [= Sénégal] (515).
'Type from Africa' [= Sénégal, since based on 139] (540).
[As *Hypnea ustulata* (Mertens ex Turner) Montagne]
Canaries (401; 404).
[As *Hypnea ustulata* Montagne]
Canaries (44).
[As *Olivia ustulata* (Montagne) Montagne]
Canaries (403).

Note. The authorities for this taxon are often cited as '(Mertens ex Turner) Kützing' or '(Mertens) Kützing.' However, it has been clearly established (*Index Nominum Genericorum*, 1979: 305) that the MSS name *Fucus ustulatus* Mertens was taken up by Turner (*Fuci* . . . II, 1809: 143) at varietal, not species, level as var. β *ustulatus* of *Fucus acicularis*, thus not employing the whole of Mertens's binomial. Hence, Mertens is of no direct relevance in authority citation. Much confusion has also attached to application of the name *Caulacanthus ustulatus* in routine determination within the list area; the situation was summarised by Steentoft (535: 126–127) in stating '*Caulacanthus* is widely reported on the Atlantic coast of Africa and it is possible that some of these records refer to *Wurdemannia*'. The record from Pagalu [= Annobón] was referred to by De Toni (139: 153) as 'Rejecta ad "Annobon" (Mildbraed)' and thus may not represent an exception to the general absence of attached records for the Gulf of Guinea (but see Lawson & John, 350). Searles (515: 51) listed authentic records from Sénégal and Namibia, the former including the type of *Caulacanthus rigidus* Kützing, a taxon embraced by Searles's earlier (515: 47) conclusion (reflecting also some earlier authors' opinions) that many 'species' of *Caulacanthus* (*C. divaricatus* (Suhr) Papenfuss; *C. spinellus* (J. Hooker et Harvey) Kützing; *C. rigidus*) for the most part represented forms of *Caulacanthus ustulatus*. The Gambia record attributed to Sourie (529: 289) is interpreted from his phraseology: 'il semble bien que la presqu'île du cap Vert en possède les plus beaux peuplements de toute la longue bande de la Mauritanie à la Casamance'. Montagne's establishment of the new genus *Olivia* (1846: 127) to receive his previous *Hypnea ustulata* was carried out in the light of his own reservations: 's'il est différent du *Caulacanthus* ou de l'*Endocladia*'; clearly, his reservations were justified. All the above confusion leads to the general assumption that, given correct generic attribution, records listed at *Caulacanthus* sp. (q.v.) are probably all based on material representative of *C. ustulatus*.

Caulacanthus sp.
Guinea-Bissau (529).
Guinée (344).
Namibia (348; 522).
Sénégal (529; 533).

Note. It is doubtful that these imprecise records relate to any other taxon than *Caulacanthus ustulatus*, although various other epithets have been employed for specimens from some of the above areas. See the entry for *C. ustulatus*.

Centroceras

Centroceras and *Ceramium* have occasionally been regarded as congeneric, mainly as a means to facilitate treatment of material seemingly providing morphologically-based links between these two genera. Simons (520: 153–154) indicated that he was persuaded to this course of action by the difficulty otherwise of deciding how to deal with *Ceramium centroceratiforme* Simons. Further work thereafter led him to conclude, in agreement with Hommersand (1963), that the genera *Ceramium*, *Centroceras*, and *Microcladia* should all be separately maintained.

Centroceras has essentially regular, basipetally-developed secondary cortical rows, the downgrowth of which is (or appears to be) even, i.e. synchronous, in time. The raised, as opposed to acropetal, growth of cortex at the upper side of each 'node' leads to the continuing discrete nature of the cortical bands. In *Ceramium*, segmentation of cortical cells is not regular, since the apical cells of the laterals which form the cortication seem to divide in many planes and unevenly. Since growth of the cortex is both acropetal and basipetal, many species of *Ceramium* have continuous cortication over at least the major part of their axes. Simons (520) also noted differences in distribution of spermatangial growth between the two genera.

Centroceras bellum Setchell & Gardner
Sierra Leone (350).
'in tropical parts of the pacific and Atlantic Oceans' (350).
[As *Centroceras* sp.]
Sierra Leone (295).

Note. The generic placement of this species has been subject to some debate. Diaz-Piferrer (1969) finally transferred *Centroceras bellum* to Børgesen's (1953) *Ceramiella*, a transfer that Børgesen himself had suggested but not effected. Hommersand (1963), after detailed study, decided to retain the species in *Centroceras*, a course of action followed by Lawson & John (350) and for the present maintained here.

Centroceras clavulatum (C. Agardh in Kunth) Montagne in Durieu de Maisonneuve
Angola (213; 298; 352).
Ascension (37; 213; 474; 475).
Benin (288; 293; 350).
Bioko (350).
Cameroun (213; 288; 337; 343; 344; 350; 484; 535; 537).

Canaries (13; 33; 38B; 38D; 71; 108; 128A; 191; 225; 226; 227; 229; 235; 238; 267A; 306B; 351; 379; 517; 567).
Cape Verde Islands (38B; 38D; 213; 407; 528; 537).
Côte d'Ivoire (287; 288; 350; 535).
Gabon (213; 294; 344; 350).
Gambia (296; 350).
Ghana (153; 213; 288; 297; 335; 338; 340; 344; 350; 491; 535; 537; 567).
Guinea-Bissau (529).
Guinée (344; 350; 384; 529; 537).
Liberia (37; 129; 133; 213; 287; 288; 350; 535).
Mauritanie (38B; 38D; 267A; 344; 349; 529; 537).
Namibia (213; 348; 522; 523).
Nigeria (213; 288; 344; 350; 535; 537).
Pagalu (213).
St Helena (213).
Salvage Islands (38B; 38D; 231).
São Tomé (93; 213; 265; 288; 344; 350; 535).
Sénégal (33; 38B; 38D; 50; 52; 108; 122; 213; 344; 408; 411; 529; 530; 535; 537).
Sierra Leone (30; 213; 295; 336; 339; 344; 535; 537).
Togo (288; 293).
'Africa' (74).
'French Equatorial Africa' (213).
'West Africa' (344).
'all warmer seas' (75).
'allen wärmeren Meeren' (224).
'Atlantico (de Cadiz a Canarias)' (517).
'Atlantique tropical et subtropical' (184).
'common everywhere' (97).
'cosmopolitan in tropical & temperate waters' (561).
'extensive' (76).
'in atlantico a Canariis ad Cap. b. Spei' (24).
'Luderitz [Namibia] to Delagoa Bay [Mozambique]' (523).
'meisten wärmeren Meeren' (266).
'Pantropical' (529).
'Pantropical element . . . less strictly tropical than others' (191).
'Seems to occur in all warmer seas' (62).
'widely distributed in the tropical and subtropical regions of the world' (276).
'widespread in rather warm and warm seas' (78).
'widespread in warm temperate and tropical seas' (350).
'world-wide . . . on tropical to warm temperate coasts' (267A).
[As *Centroceras clavulatum* (C. Agardh) Montagne]
Namibia (36B).
'probably the most widespread of the Ceramiaceae in the Gulf of Guinea' (350; 535).
'seems to occur in all warmer seas' (61).
[As *Centroceras clavulatum* Agardh]
Canaries (142; 391).
St Helena (142; 391).
'in atlantico a Canariis ad Cap. b. spei' (24).
'warmer seas of both hemispheres' (257).
[As *Centroceras clavulatum* Kützing]
'widely distributed in both hemispheres' (145).
[As *Centroceras clavulatum* (Agardh) Kützing]
Cape Verde Islands (191).
'Élement pantropical' (191).

[As *Centroceras clavulatum* Montagne]
Angola (41; 42).
Cameroun (500).
Canaries (16; 33; 41; 196; 403; 489; 517; 555).
Cape Verde Islands (408; 528; 555).
Mauritanie (555).
Salvage Islands (555).
Sénégal (33; 59; 122; 555).
'Atlantico (de Cadiz a Canarias)' (517).
'Atlantique (depuis le sud du Portugal jusqu'à Dakar, Canaries . . .)' (33).
'throughout all tropical and subtropical seas' (41).
[As *Centroceras clavulatum* J. G. Agardh]
St Helena (260).
'Generally diffused in tropical and subtropical seas, and extending into the south temperate zone' (259).
[As *Centroceras cryptacanthum* Kützing]
Cape Verde Islands (38; 145; 259).
[As *Centroceras hyalacanthum* Kützing]
Cape Verde Islands (38; 145).
São Tomé (251; 263; 264).
[As *Centroceras inerme* Kützing]
Gabon (133; 249; 318).
Senegambia (321; 454).

Note. Although Kützing (318: 688) earlier stated 'In ostio rivi Gabon (Guinea). (v.s.) – Specimen dedit amic. Lenormand.', he later simplified his overall statement (321) to merely 'Ad oras Senegambiae'. The validity of area attribution in both cases is thus left in some doubt.

[As *Centroceras clavulatum* Agardh var. *crispulum* Montagne]
'Throughout all tropical and subtropical seas' (410).
[As *Ceramium (Centroceras) clavulatum* J. Agardh]
Canaries (38; 547).
Cape Verde Islands (38).
'généralement dans les Mers chaudes' (38).
'l'Océan Atlantique, du Maroc et des Canaries au Cap de Bonne Espérance' (38).
'very widely distributed in warmer waters' (213).
[As *Ceramium (Centroceras) clavulatum* Agardh *ap.* Kunth]
Canaries (89).
Congo (249).
Gabon (249).
'Des Canaries au cap de Bonne-Espérance' (89).
[As *Ceramium clavulatum* C. Agardh in Kunth]
Ascension (133).
Cameroun (454; 500).
Canaries (44; 133; 216; 401; 482; 499).
Cape Verde Islands (499).
Pagalu (456; 457).
Salvage Islands (216).
'Nordwestafrika' (499).
'Westafrika' (499).
'allen wärmeren Meeren' (482).
'Atlantisches Ozean: Von Gibraltar südwärts bis zum Kap der Guten Hoffnung' (499).
'Aus den meisten wärmeren Meeren' (266; 483).
'in oceanis calidioribus ubique; in Atlantico a Canariis et Gibraltar ad Caput Bonae Spei, insulam S. Pauli et insulam . . . Ascensionis' (133).

[As *Ceramium clavatulum* (sic!) C. Agardh in Kunth]
Namibia (158; 453).
[As *Ceramium clavulosum* Agardh]
São Tomé (251; 265).
[As *Ceramium clavulatum* J. Agardh var. *cryptacanthum* [= *Centroceras cryptacanthum* Kützing]]
Cape Verde Islands (38; 145).
[As *Ceramium clavulatum* J. Agardh var. *hyalacanthum* (Kützing) Askenasy [= *Centroceras hyalacanthum* Kützing]]
Cape Verde Islands (38).
[As *Ceramium clavulatum* C. Agardh var. *inerme* Kützing]
Canaries (554).
Senegambia (296; 554).

Note. The Senegambia record in Weber-van Bosse (554) is based solely and directly on Kützing (321); see earlier in this present entry for the record in 321.

[As *Spyridia clavulata* (Agardh *apud* Kunth) J. Agardh]
Canaries (404).

Centroceras cryptacanthum Kützing
See *Centroceras clavulatum* (C. Agardh in Kunth) Montagne.

Centroceras hyalacanthum Kützing
See *Centroceras clavulatum* (C. Agardh in Kunth) Montagne.

Centroceras inerme Kützing
See *Centroceras clavulatum* (C. Agardh in Kunth) Montagne.

Centroceras spp.
Cameroun (533).
Ghana (344; 487).
Mauritanie (529).
Sénégal (529; 533).
Sierra Leone (295; 374).
'African west coast' (374).
'West Africa' (344; 479).

Note. The record in Round (487) is based on various works by Lawson & John. For re-allocation to *Centroceras bellum* Setchell & Gardner of the record in John & Lawson (295), see the entry for *C. bellum*; the authors (295) had already commented on the close similarity, perhaps identity, of their *Centroceras* sp. with *C. bellum*. The generalised distribution presented in Levring (374) was based on work by Lawson (337; 338; 339; 340).

Ceramiaceae
Undetermined material clearly referable to this family has been reported in various of the works relevant to the list area. Lawson & John (350) detected such specimens, all lacking reproductive stages, in Bioko, Gabon, and Ghana. Weisscher (556: 59) found precisely similar circumstances applying to material from Selvagem Pequena (Salvage Islands); his illustration would seem to suggest either *Spermothamnion* or *Ptilothamnion*, although no entry has been recorded here on that slender basis. Further reports from the Salvage Islands of specimens that could be identified no further than family were presented in Audiffred & Weisscher (38B).

Ceramiella spp.
See *Centroceras bellum* Setchell & Gardner.

Ceramium
In southern Africa, this genus has been examined in some detail by Simons (520); his studies included material from Namibia. See the note to *Centroceras* for comments on the separate status of these two genera. It is probable that there is a great deal more floristic correspondence, for these and similar genera, between the southern half of the present list area and South Africa itself than would be immediately apparent from the currently available sparse literature and record data. In any general assessment of available background on this present genus, the papers

by Itono (276) and by Womersley (1978) are of considerable importance. The general conclusion, in any event, is that *Ceramium* does not lie amongst the genera of which the taxonomic treatment is comparatively easy.

Ceramium acanthonotum (Harvey in W. Hooker) J. Agardh
See the entries for *Ceramium ciliatum* (Ellis) Ducluzeau, *Ceramium flabelligerum* J. Agardh, and *Ceramium shuttleworthianum* (Kützing) Rabenhorst.

Note. This taxon, often referred to as *Ceramium acanthonotum* Carmichael, was reported from the Canary Islands by Sauvageau (493: 53). Børgesen (71: 66) added a note at the end of his entry for *Ceramium*, stating: 'Sauvageau mentions *Ceramium acanthonotum* Carm. as found at the Canary Islands. Dr. H. E. Petersen has examined the specimens of Sauvageau and has found that these contain partly *Ceramium ciliatum* and partly *Ceramium flabelligerum*.' This Børgesen note is the basis of the allocation here of the records concerned.

Ceramium arachnoideum Welwitsch [non J. Agardh]
See *Murrayella periclados* (C. Agardh) Schmitz.

Note. This is a manuscript name taken from herbarium specimens (e.g. in BM) and based on material collected by Welwitsch (1853) at Cabo Lombo, Loanda [= Luanda], Angola. Subsequent work by Post (458: 79, 81) has established that the true identity of at least the BM specimens is *Murrayella periclados* (q.v.).

Ceramium arenarium Simons
Namibia (36B; 348; 520; 522).

Note. The records in Lawson & Isaac (348) are based solely and directly on Simons's information published in 520 and amplified in 522. The taxon is in some ways reminiscent of *Ceramium tenerrimum* (Martens) Okamura (both have partially exserted tetrasporangia), but *C. arenarium* has characteristically circinnate apices, contiguous genicula distally, and more or less median pericentrals. The epithet was derived from its sandy habitat amongst other 'turf' algae. Its presence in Namibia is not surprising, since the type was from Port Nolloth, Namaqualand, South Africa, very near the Namibian border; it would not be unlikely for the distribution range to extend into similar sandy areas of southern Angola.

Ceramium atrorubescens Kylin
Namibia (36B; 348; 520; 522).

Note. The records in Lawson & Isaac (348) are based directly on Simons's information published in 520 and amplified in 522. Simons (520: 161) commented at length on the apparent relationships between this taxon, *Ceramium arenarium* Simons, and *C. circinnatum* (Kützing) J. Agardh. Further work is required to establish firmly the distinctness of these taxa. Material currently identified as *C. atrorubescens* seems to be widespread at least northwards to Swakopmund, Namibia.

Ceramium brasiliense Joly
See the terminal note to *Ceramium uruguayense* W. R. Taylor.

Ceramium byssoideum Harvey
See *Ceramium flaccidum* (Kützing) Ardissone.

Ceramium capense Kützing
Namibia (348; 520; 522).

Note. Simons (520: 164) presented data to show why he felt unable to accept the recombination in *Microcladia* suggested by Papenfuss (1940: 223). In view of that, the retention for the present in *Ceramium* was accepted by Seagrief (1984) and has been maintained here. Briefly, Simons discussed the differential relationships of *C. capense* and the taxon Papenfuss designated as *Microcladia capensis* (Kützing) Papenfuss, respectively, with *Ceramium rubrum* (Hudson) C. Agardh and *Ceramium vimineum* J. Agardh. Apart from the differences thus deduced, Simons concluded that *C. capense* is a form of *Ceramium obsoletum* C. Agardh (q.v.) but, pending examination of the type of the former, made no formal proposal of synonymy as it would require renaming of the Papenfuss taxon, if separate. For the distinctions between *C. capense* and *C. planum* Kützing, see the notes to the latter entry.

Ceramium ciliatum (Ellis) Ducluzeau
Canaries (8; 13; 16; 38B; 38C; 38D; 71; 89; 133; 191; 216; 226; 227; 229; 230; 235; 237; 253; 275; 276; 302; 304; 306B; 375; 379; 390; 392; 413; 489; 490; 499; 517; 555; 556).
Cape Verde Islands (38B; 38C; 38D; 71; 140; 499; 500; 555; 556).

Salvage Islands (38B; 38C; 38D; 231; 375; 555; 556; 556A).
Sénégal (408).
'Atlantico (de Faeroes a Canarias)' (517).
'Atlántico Oriental (Isla Feroes – Canarias)' (253).
'Atlantique (des Feroes aux Canaries)' (33).
'Atlantischer Ozean: Mittelmeer und angrenzende Teile des freien Ozeans, südwärts bis nach Brasilien' (499).
'cosmopolite dans les régions tempérées des deux hémisphères' (221).
'dans l'océan Atlantique, des îles Feroë aux îles du Cap Vert' (140).
'Des îles Feroë aux Canaries' (38; 89).
'Faeroe Ils. to Canary Ils' (413).
'Faeroes southwards to the Canary Islands' (71).
[As *Ceramium ciliatum* Ducluzeau]
Canaries (44; 401; 439).
Cape Verde Islands (38; 528).
'Des îles Feroë aux Canaries' (38; 89).
[As *Ceramium ciliatum* Ducl. Lyngb.]
Cape Verde Islands (528).
[As *Ceramium ciliatum* Ellis]
Salvage Islands (215; 216).
[As *Ceramium ciliatum* (Ellis) Ducluzeau var. *robustum* (J. Agardh) G. Mazoyer]
Canaries (275; 546).
[As *Ceramium acanthonotum* Carmichael]
Canaries (493).

Note. For the rationale behind the attribution here of the *Ceramium acanthonotum* record from the Canaries (493), see the note to that species. Many previous authors, including Ardré (33: 149) and Dixon (1962: 252), have commented on the notorious difficulty of determination within the group of taxa close to *C. ciliatum*. The question of whether one is dealing with a single polymorphic species of considerable potential variation under different environmental conditions, or with different genomes of which the morphological expressions overlap, remains largely unresolved. See also the record presented under the sub-heading for *Ceramium rubrum* (Hudson) C. Agardh var. *botryoides* Montagne, in the entry for *C. rubrum*.

Ceramium cingulatum Weber-van Bosse
See *Ceramium strobiliforme* G. W. Lawson & D. John.

Ceramium circinnatum (Kützing) J. Agardh
See *Ceramium atrorubescens* Kylin.

Ceramium clavatulum [sic!] J. Agardh
See *Centroceras clavulatum* (C. Agardh in Kunth) Montagne.

Ceramium clavulatum *auct.*
See *Centroceras clavulatum* (C. Agardh in Kunth) Montagne.

Ceramium clavulatum C. Agardh
See *Centroceras clavulatum* (C. Agardh in Kunth) Montagne.

Ceramium codii (Richards) G. Mazoyer
Canaries (38B; 38C; 232B; 556; 556A).
Ghana (350; 376; 377; 491).
Salvage Islands (38B; 38C; 556; 556A).
Sénégal (38B; 38C; 59: 556).
Sierra Leone (?295).
Togo (?293; ?350).
'Probably widespread in warm temperate and tropical seas' (350).

Note. The record for Sierra Leone (John & Lawson, 295) is expressed with some doubt, since the material was determined definitively no further than to genus. It is attributed here because of the added comment that, in one collection at least, plants with simple nodal structure might well represent poorly-developed *Ceramium codii*.

Ceramium compactum (Bory) J. Price, **comb. nov.**
Basionym: *Boryna compacta* Bory in Duperrey, *Voy. monde, Cryptogamie*: 221 (1829).
[As *Boryna compacta* Bory de St-Vincent]
Ascension (24; 91; 260).

Note. The genus *Boryna* Grateloup in Bory (1822; *Dict. class. Hist. nat.* **II**: 412–413) is founded on taxa otherwise (previously and since) mostly recognised as representative of the genus *Ceramium*. There is nothing in the valid but somewhat sparse Latin description of the species *B. compacta* by Bory (1829: 221) to indicate that *B. compacta* cannot have been representative of *Ceramium*. Therefore, in the absence of any attempted typification and examination of the declared type, the new combination in *Ceramium* is made here for rationalisation of treatment. It was not possible in the present context to resolve the whole problem of identity of the Ascension material.

Ceramium corniculatum P. Dangeard
Sénégal (59).

Ceramium cornutum P. Dangeard
Ghana (350).
Sénégal (47; 122).
'in warm temperate and tropical parts of the eastern Atlantic Ocean' (350).

Ceramium corticatulum Kylin
Sénégal (?542).

Note. The distinctions (nature of the cortication) put forward by Kylin (1907: 176–177; 1944: 67) as the basis for separation of this taxon from the closely-similar *Ceramium strictum* Harvey are not fully convincing. There is the additional doubt that a 'species', otherwise known only from the northern European (especially Swedish) coasts, should occur on the coast of Sénégal and not along the coasts between. By contrast, there are abundant intermediate reports of *Ceramium strictum* itself along the eastern side of the north Atlantic, a situation that suggests the presence of variable manifestation of a single genome, rather than of distinct breeding groups that might be called 'species'. Trochain himself (542: 109, no. 22) expressed doubt, presumably as to determination of the material, derived from comments on the specimens by J. Feldmann. The record is retained here until such time as it is possible to provide a more definitive assessment.

Ceramium diaphanum (Lightfoot) Roth
Angola (239; 352).
Canaries (5; 13; 38B; 38C; 38D; 71; 122; 128A; 191; 226; 227; 229; 230; 235; 237; 302; 304; 306B; 379; 392; 401).
Cape Verde Islands (38B; 38C; 38D; 239; 499).
Mauritanie (349).
Namibia (128; 158; 348; 522).
Salvage Islands (38B; 38C; 38D; 231; 375).
Sénégal (38B; 38C; 38D; 499).
'Nordwestafrika' (499).
'Westafrika' (499).
'in Atlantischen Ozean von den nordeuropaïschen Küsten bis zum Kap der Guten Hoffnung' (499).
'Wahrscheinlich kosmopolitisch' (330).
[As *Ceramium diaphanum* Roth]
Angola (41; 42).
Canaries (44; 401).
Cape Verde Islands (38).
[As *Ceramium diaphanum* (Roth) Harvey]
Canaries (16; 225; 253; 489; 517; 546; 555; 556).
Cape Verde Islands (555; 556).
Guinea-Bissau (529).

Salvage Islands (555; 556).
Sénégal (122; 529; 542; 555; 556).
'Atlántico (Inglaterra-Canarias . . .)' (253).
'Atlantique (de l'Angleterre à la Mauritanie)' (33).
'Atlantique: des côtes anglaises à la Mauritanie' (222).
'Cosmopolite/subcosmopolite' (529).

Note. The Canaries record in Benítez (44) is based solely on that in Montagne (401); similarly, that for Mauritanie in Lawson & John (349) derives from the distribution statements in Ardré (33) and Gayral (222). For entries concerning the citation of var. *strictum auct.* of *Ceramium diaphanum*, see the entry for *C. strictum*. See also the notes to the entry for *C. elegans* (Roth) Ducluzeau.

We do not here accord taxonomic importance to the varieties of *C. diaphanum* recognized by certain other authors (e.g. Simons, 520, on South Africa). The latter both accepted the var. *pulchellum* of *C. diaphanum* (based on *Ceramium pulchellum* (Kützing) Kylin) and established the further variety *capense* Simons.

Ceramium echionotum J. Agardh
Canaries (5; 13; 16; 38B; 38C; 38D; 71; 128A; 191; 216; 225; 226; 227; 229; 230; 253; 302; 304; 306B; 375; 390; 441; 444; 499; 517; 546; 547; 555; 556).
Salvage Islands (38B; 38C; 38D; 215; 216; 231; 375; 555; 556).
'Atlantico (de Inglaterra a Canarias)' (517).
'Atlántico Oriental (Inglaterra-Canarias)' (253).
'Atlantique (de l'Angleterre aux Canaries)' (33).
'Atlantischer Ozean, von den englischen Küsten an südwärts bis zur nordwestafrikanischen Küste' (499).
'Du nord de la Grande-Bretagne aux Canaries' (89).
'English coast southwards to the Canary Islands' (71).

Note. The specific epithet is often mis-rendered *'echinotum'*; see also the entry for *Ceramium* spp. (Canaries).

Ceramium elegans (Roth) Ducluzeau
[As *Ceramium elegans* Ducluzeau]
Cape Verde Islands (38; 408).
Salvage Islands (215; 216).
'In mediterraneo et atlantico calidiore' (27).
'Mers chaudes de l'Atlantique' (38).

Note. Gain & Mirande (216) indicated 'Non signalé aux Canaries, mais il en existe dans l'herbier Bornet des échantillons provenant de Madère'.

Given consistency and efficacy in the above determinations, it may well be that the records should be associated with *Ceramium diaphanum* (Lightfoot) Roth (q.v.). Ducluzeau (1806: 53–61) considered that his *Ceramium elegans* was identical with that named by Lightfoot, Hudson, and Roth as *Ceramium diaphanum*. Roth, of these three authors, was inconsistent in that he had elsewhere (1797: 199–200) used the name *Conferva elegans*, commenting (p. 200): 'Pro *Conferva diaphana Lightfoot* Flor. Scot. n. 24. facile haberi possit mea Conferva, si filamenta ramosissime et rami apice forcipati essent.' Because he regarded the name *Conferva diaphana* [*Ceramium diaphanum* (Lightfoot) Roth] as confused, Ducluzeau (1806: 56) stated: 'J'ai préféré néanmoins le nom specifique d'*elegans* donné par Roth, à celui de *diaphanum* adopté avant lui par Lightfoot, parce que ce dernier est applicable à plusieurs autres espèces.'

Ceramium equisetoides Dawson
See the notes to the entry for *Ceramium strobiliforme* G. W. Lawson & D. John.

Ceramium fastigiatum (Roth) Harvey in J. Hooker
Ascension (475).
Sierra Leone (32).

Note. See the notes to the entry on *Ceramium taylorii* Dawson for comment on possible previous confusions between these two taxa.

Ceramium fastigiatum (Roth) Harvey forma **flaccida** H. E. Petersen in Børgesen
Sierra Leone (30; 32; 350).

'warmer parts of the Atlantic Ocean' (62; 97).

Note. This first definitely located record (Aleem, 30) from the eastern side of the Atlantic was repeated in Lawson & John (350), although the latter authors considered the record doubtful until material was further examined and verified.

Ceramium flabelligerum J. Agardh
Canaries (16; 71; 191; 214; 225; 227; 229; 235; 306B; 351; 490; 493; 517; 546).
'Atlántico de Inglaterra a islas Canarias' (191).
'English coast southwards to the Canary Islands' (71).
[As *Ceramium acanthonotum* Carmichael]
Canaries (493).

Note. The material reported as *Ceramium acanthonotum* (q.v.) by Sauvageau (493) was found by Petersen (in Børgesen, 71) to be a mixture of *C. ciliatum* (q.v.) and *C. flabelligerum*.

Ceramium flaccidum (Kützing) Ardissone
[As *Ceramium gracillimum* (Kützing) Griffiths & Harvey *in* [or *ex*] Harvey]
Ascension (474).
Canaries (33; 38B; 38D; 226; 238; 375; 379; 413).
Cape Verde Islands (375).
Congo (350).
Ghana (377).
Mauritanie (38B; 38D).
Salvage Islands (38B; 38D).
Sénégal (33; 38B; 38D).
Western Sahara (38B; 38D).
'African and American coasts, Canary Islands' (250).
'Atlantique (de l'Angleterre aux Canaries, Cap Vert)' (33).
'British Isles southward to the Cape Verde Islands' (375).
'desde las islas Británicas a Cabo Verde' (238).
'world-wide . . . on tropical to warm temperate coasts' (267A).

Note. The record in Price & John (474) was of material taken from the gut of an Ascension Island black-fish in immediately coastal waters.

[As *Ceramium gracillimum* Griffiths & Harvey]
Canaries (177; 546).
Congo (249; 250).
São Tomé (133).
Sénégal (59).
'Atlantic Ocean (. . . African . . . coasts, Canary Islands' (177).
'Parece existir en todos los mares calidos' (546).
[As *Ceramium gracillimum* Harvey]
Canaries (16; 229; 235; 236).
Ghana (491).

Note. The specific epithet is rendered *'gracillinum'* in Gonzalez Henriquez (235).

[As *Ceramium gracillimum* (Grif.) [sic!] Harvey]
Sénégal (59; 529).
[As *Ceramium gracillimum* (Kützing) Griffiths & Harvey in Harvey var. *byssoideum* (Harvey) G. Mazoyer]
Angola (352).
Ascension (475).
Cameroun (350).
Canaries (191; 227).
Gabon (294; 350).
Ghana (293; 350).
Liberia (129; 350).
Mauritanie (349).

São Tomé (350; 535).
Sénégal (122; 529).
Sierra Leone (295; 350).
Western Sahara (349).
'semble exister dans toutes les mers chaudes' (86; 196).
'Probably in all warm seas' (97).
[As *Ceramium gracillimum* Griffiths & Harvey var. *byssoideum* (Harvey) G. Mazoyer]
Canaries (556).
Cape Verde Islands (556).
Mauritanie (556).
Salvage Islands (556; 556A; 557).
São Tomé (93).
Sénégal (556).
Western Sahara (556).
'sans doute répandu dans toutes les mers chaudes' (190).

Note. Mis-spellings of authority names, since not a source of confusion in this case in the text of Carpine (93), have been ignored.

[As *Ceramium byssoideum* Harvey]
Sénégal (50).
Sierra Leone (30).
[As *Ceramium taylorii* Dawson]
Cameroun (350).
Ghana (377).
'probably cosmopolitan' (350).
[As *Ceramium transversale* Collins & Hervey]
Canaries (71; 83; 235).

Note. The application of names, synonymy, and limits of taxa amongst the many 'species' related to the taxon previously known as *Ceramium gracillimum* Griffiths & Harvey ex Harvey (other variants of the authorities are often encountered) have recently been critically revised by Womersley (1978: 234–238). He has concluded (in most cases at least partly on the basis of examination of the type or authentic materials) that a long list of names previously employed should be reduced to the synonymy of *Ceramium flaccidum*. An extensive list along similar lines was also previously presented by Nakamura (413). Many of the names in both lists have been applied to specimens of *Ceramium* from the present list area. Womersley (loc. cit.) clearly went to much greater lengths than does most more routine work in confirming application of synonymy through relevant type material; for present purposes, on grounds of available time and limitations in concept, we have had to make the assumption that previous routine application of names was sufficiently careful and accurate to warrant transfer of the records concerned to *C. flaccidum* (Kützing) Ardissone.

As with most parts of the world, the present list area shows definite need for more critical analysis of species of *Ceramium* present, of suggested segregate genera, and of other closely allied groups. Transfer to *Ceramium flaccidum* of records established under the following names is accepted here, pending area revision: *Ceramium gracillimum* (Kützing) Griffiths & Harvey ex Harvey (and other authority variants), *C. gracillimum* var. *byssoideum* (Harvey) G. Mazoyer, *C. byssoideum* Harvey, *C. transversale* Collins & Hervey, *C. taylorii* Dawson, *C. masonii* Dawson, *C. pulchellum* (Kützing) Grunow.

It is strongly possible, from both Womersley's comments and data presented by Simons (520), that *Ceramium papenfussianum* Simons (q.v., for records from Namibia) is also a synonym of *C. flaccidum*. See, for additional support data and comments, Norris & Bucher (416) and Itono (275).

Ceramium fruticulosum Bonnemaison
See *Callithamnion corymbosum* (J. E. Smith) Lyngbye.

Ceramium fucoides
For reference to a Canaries specimen so named by Broussonnet, see *Halymenia capensis* Montagne.

Ceramium gracillimum (Kützing) Griffiths & Harvey ex Harvey (or other authority variants)
See *Ceramium flaccidum* (Kützing) Ardissone.

Ceramium gracillimum var. **byssoideum** (Harvey) Mazoyer
See *Ceramium flaccidum* (Kützing) Ardissone.

Ceramium ledermannii Pilger
Cameroun (139; 288; 350; 454).
Côte d'Ivoire (288; 350).
Gabon (294; 350).
Liberia (129; 288; 350).
'in the tropical parts of the eastern Atlantic Ocean' (350).

Note. Pilger (456) distinguished between *Ceramium ledermannii* and his later *C. leptosiphon* (q.v.) on the bases of differences in cell dimensions/proportions and development of cortical bands.

Ceramium leptosiphon Pilger
Pagalu (139; 350; 456; 457; 496).

Note. All subsequent literature statements are based solely and directly on Pilger's original publication (456). See the note to *Ceramium ledermannii* for details of the slender distinctions between the two taxa; since (cf. De Toni, 139: 507) *C. leptosiphon* to date remains 'Fructus ignoti', its validity as a taxon must be viewed with some doubt.

Ceramium masonii Dawson

Note. See the terminal notes to the entry for *Ceramium flaccidum* (Kützing) Ardissone. For reference to specimens with some resemblances to *C. masonii* and collected in Cameroun and Ghana, see Lawson & John (350: 286). These same records are listed under the sub-heading for *Ceramium gracillimum* (Kützing) Griffiths & Harvey in Harvey var. *byssoideum* (Harvey) G. Mazoyer, within the body of the entry for *C. flaccidum*.

Ceramium mazatlanense Dawson
Angola (352).
Gabon (294; 350).
Ghana (350; 377).
'probably pan-tropical' (350).

Note. According to Cribb (113: 86), Dawson (1954) noted the possibility that *Ceramium mazatlanense* and *C. cruciatum* Collins & Hervey (1917, no. 106) may be conspecific. If that emerges as correct and there are no additional nomenclatural complications, *C. cruciatum* will antedate as the correct name.

Ceramium obsoletum C. Agardh
Namibia (158).
[As *Ceramium obsolatum* Agardh]
Namibia (128).

Note. Simons (520: 164) suggested that *Ceramium capense* Kützing (q.v.) is probably a form of *C. obsoletum* C. Agardh; he hesitated to make definite changes in this direction until the type of *C. capense* has been re-examined.

Ceramium papenfussianum Simons
Namibia (348; 522).

Note. Possibly a synonym of *Ceramium flaccidum* (Kützing) Ardissone; see the terminal notes to the latter. The record in Lawson & Isaac (348) is based solely on that in Simons (522). Simons himself provided reasons for not accepting the synonymy of *C. papenfussianum* with *C. flaccidum*, although he has not generally been followed, cf. Womersley (1978).

Ceramium planum Kützing
Namibia (36B; 348; 522).

Note. The record in Lawson & Isaac (348) is based directly on the entry in Simons's list (522). Simons had earlier (520) outlined differences and similarities between *Ceramium planum* and *C. capense* Kützing (q.v.). For the possibilities of other generic placement of the present taxon, see Simons (1968); *Campylaephora* seems to be the most likely re-assignment.

Ceramium poeppigianum Grunow
Cape Verde Islands (37; 38; 100; 183; 267B).
'communes aux îles du Cap Vert et à l'Afrique méridionale' (38).

[As *Reinboldiella poeppigiana* (Grunow) J. Feldmann & G. Mazoyer]
Cape Verde Islands (191; 195A).
[As *Reinboldiella* sp.]
Cape Verde Islands (214A).

Note. The reference to *Reinboldiella* sp. is a not uncommon reduced citation of a record from a generalized article clearly based on a more precise original source (195A). Feldmann (191: 428) indicated that he and G. Feldmann-Mazoyer had in 1937 compared the Chevalier (100) Cape Verde Islands material with Grunow's Natal type-material, finding them identical. More recently, Hommersand (267B: 225–234) concluded that: 'Although *C. poeppigianum* is a very distinctive species of *Ceramium*, there appear to be insufficient grounds for considering it a new genus' and 'there are a number of important characters that distinguish the South African plant [*Reinboldiella poeppigianum*] from the type species of *Reinboldiella*'. Hence, we have accepted here the maintenance of the taxon in *Ceramium*.

Ceramium pulchellum (Kützing) Grunow

Note. See the notes to *Ceramium diaphanum* (Lightfoot) Roth and *Ceramium flaccidum* (Kützing) Ardissone. Womersley (1978) has established the likelihood that most usage of the name *C. pulchellum* has related to material that would now be taken as representative of *C. flaccidum*. However, he (1978: 237–238) could not locate the type of *C. pulchellum* in Leiden. Womersley used material of Isaac's in ADU; that seen previously (1961) and annotated by Simons as *C. pulchellum* proved to be typical plants of *C. flaccidum*. Kützing's type of *C. pulchellum* therefore still requires locating and examination; in any case, the nomenclatural combination is invalid since antedated by *Ceramium pulchellum* C. Agardh (1811: 19), a Swedish freshwater alga.

Ceramium rubrum (Hudson) C. Agardh
Canaries (2; 13; 16; 38B; 71; 128A; 191; 225; 226; 227; 229; 230; 231; 232B; 235; 236; 237; 238; 253; 301; 306B; 379; 401; 489; 499; 517).
Salvage Islands (38B).
Western Sahara (38B; 349).
'Allegemein verbreitet' (37).
'Atlántico (Europe-Canarias . . .)' (253).
'Kosmopolitisch' (330).
'Nordwestafrika' (499).
'temperate zones of both hemispheres; also in the tropical ocean, east and west' (306).
[As *Ceramium rubrum* Agardh]
Canaries (44).
'cosmopolite dans les deux hémisphères' (221; 222).
'Dans toutes les mers' (89).
'Throughout all seas' (410).
[As *Ceramium rubrum* var.]
Canaries (301).
[As *Ceramium rubrum* (Hudson) C. Agardh var. *botryoides* Montagne]
Canaries (401).

Note. This record probably represents a spinous species of *Ceramium*; Montagne (401: 173) commented regarding his variety that it was distinguished by the form of the plastids and by the presence of some spines. These spines occupied the abaxial side of the last two (forcipate) branchings, along the whole branching; the rest of the plant was bare: 'Ce n'en est pas moins un passage aux *C. clavatum* et *ciliatum*.'

[As *Ceramium rubrum* (Hudson) C. Agardh var. *Liebetruthii* Grunow in Piccone]
Canaries (133; 390; 439).
[As *Ceramium rubrum* (Hudson) Agardh var. *virgata* Agardh]
Africa (74).

Note. The Canaries record in Benítez (44) was based directly on Montagne (401); as with other complex entries, this is one instance only of a range of secondary citation. Lawson & John (349) noted for their record from Western Sahara that the species had: 'not previously been reported further south than Morocco on the West African coast.' The taxonomic and biological status of this species is in some doubt. It probably represents an aggregate of ill-defined but still at least partially separate breeding groups, not always accurately reflected in the perceived morphological distinctions utilized in taxonomic practice.

Ceramium shuttleworthianum (Kützing) Rabenhorst

Note. See the entry for *Ceramium acanthonotum* (Harvey in W. Hooker) J. Agardh. On the basis of the nomenclature alone, the Canaries record published by Sauvageau (493: 53) of the species '*C. acanthonotum* Carmichael' would be attributed here. However, further work on the specimens concerned by H. E. Petersen revealed that the material represented other taxa in *Ceramium*.

Ceramium strictum Harvey
Canaries (38D; 128A; 227; 493).
Mauritanie (38D; 349).
Sénégal (38D; 59).
'Nordwestafrika' (499).
'Warmer parts of the Atlantic' (83; 375).
[As *Ceramium strictum* Greville & Harvey]
Canaries (71; 191).
'Nordwestafrika' (499).
'Warmer shores [parts] of the Atlantic Ocean' (62; 71; 176).
[As *Ceramium strictum* Greville & Harvey in Harvey]
Canaries (108).
[As *Ceramium strictum* (Kützing) Harvey]
Canaries (279).
Sénégal (59; 122).
[As *Ceramium diaphanum* var. *strictum* (Kützing) Harvey]
Sénégal (59).

Note. There has always been difference of opinion on the authorities and attribution of this species, mainly consequent on its close similarities to *Ceramium diaphanum* (Lightfoot) Roth (q.v.). Varietal level under the latter species has often been the decision finally adopted, as in Boudouresque et al. (1984: 48), who referred to the taxon as 'var. *strictum* (Kützing) Feldmann-Mazoyer.' Since we are not thus far convinced either way about the arguments for and against species-level cf. varietal-level, the species-level nomenclature is maintained pending clarification. The question of identity of the Harvey concept with the Kützing concept of the taxon, at whatever taxonomic level, is also strongly involved.

Ceramium strobiliforme G. W. Lawson & D. John
Ghana (350; 377).
'tropical West Africa' (350).

Note. Lawson & John (350) indicated that their plant bears a superficial resemblance to *Ceramium cingulatum* Weber-van Bosse and to *Ceramium equisetoides* Dawson. The Ghanaian plants of *C. strobiliforme* appear to differ from the other two taxa in overall dimensions, in shape of the branch tips, and in a lesser extent of cortication.

Ceramium taylorii Dawson
See the entry for *Ceramium flaccidum* (Kützing) Ardissone.

Ceramium tenerrimum (Martens) Okamura
Canaries (517).
Guinée (344; 350; 450; 451; 529).
Sénégal (59; 122; 529; 530).
'Atlantique (. . . Cap Vert . . .)' [= Sénégal] (33).
'Atlántico tropical' (546).
'in warm temperate and tropical parts of the Atlantic' (350).
'Pantropical' (529).

Note. We can trace no basis in Børgesen's work on the Canary Islands for the record stated by Seoane-Camba (517) to originate from him. Similarly, Cordeiro-Marino's (108) record for 'Arquipélago de Cabo Verde' results from a misunderstanding of Ardré's (33: 153) 'Cap Vert' statement, on which it is based. It is most probable that *Ceramium tenerrimum* will be detected in Nambia and in all areas between Guinée, Sénégal, and South Africa. Simons (520: 157–159) recorded it as widely present in South Africa, including a report from Port Nolloth, Namaqualand, very near the southern border of Namibia.

Ceramium tenuissimum (Roth) Areschoug
[As *Ceramium tenuissimum* (Roth) J. Agardh]
Angola (352).
Cameroun (288; 337; 350; 537).
Côte d'Ivoire (288; 350).
Ghana (377).
Sierra Leone (295; 350).
'widespread in warm temperate and tropical seas' (350).
[As *Ceramium tenuissimum* (Lyngbye) J. Agardh]
Ascension (475).
Canaries (232B).
Cape Verde Islands (100; 183; 556).
Salvage Islands (38B; 556).
[As *Ceramium tenuissimum* J. Agardh]
Salvage Islands (231).
[As *Ceramium tenuissimum* (Lyngbye) C. Agardh]
Canaries (253).
'Atlántico (Escandinavia – costas oueste africanas . . .)' (253).

Note. Silva (review of Lawson & John, 350; *Nova Hedwigia* **36**: 809–812, 1983 ['1982']) has commented on the situation regarding citation of authorities for this species. We follow him here in citing authorities as '(Roth) Areschoug', although we are not currently able to resolve the problem of the name as a later homonym of *C. tennuissimum* Bonnemaison (1828). Excessive checking of the morphological concepts behind the application of names would be necessary to conclude on the correct name to be applied; derivation of a new epithet may be required to solve the nomenclatural situation. This will be undertaken in the revised version of the overall list, to be published in due course. The record published in John (288) for the Côte d'Ivoire was based on material collected there by Sourie and held in Paris. The reports by Feldmann (183) and Chevalier (100) from the Cape Verde Islands were presented with some doubt, presumably as to determination. Weisscher (556: 61) recorded the species for the Salvage Islands but added: 'Listed by Gil-Rodriguez et al. (1978: 69), not found by us.' The Gil-Rodriguez et al. reference can be found in our present listing at 231.

Ceramium transversale Collins & Hervey
See *Ceramium flaccidum* (Kützing) Ardissone.

Ceramium uruguayense W. R. Taylor
Sénégal (59).

Note. According to Cordeiro-Marino (108), *Ceramium uruguayense* is close to *C. brasiliense* Joly; this is not surprising, in view of the contiguity of the geographical areas from which they are described. The apparent occurrence of taxa on both sides of the Atlantic, although not fully possible of assessment in the absence of detailed knowledge of the flora of all areas concerned, is similarly not especially surprising since variable patterns of understanding as to what constitutes a 'species' lead in turn to imprecise application of names and conceptual difficulties in complex genera. Exactly what significance may attach to the supposed presence of *C. uruguayense* in Sénégal therefore remains unclear.

Ceramium vimineum J. Agardh
See the terminal note to *Ceramium capense* Kützing.

Ceramium sp. A
Benin (293).
Togo (293).

Note. Includes material with morphology close to *Ceramium codii* (Richards) G. Mazoyer (q.v.).

Ceramium sp. B.
Benin (293).
Togo (293).

Note. Very small, and as yet completely unidentified; see John & Lawson (293).

Ceramium spp.
Angola (352; 500).

Ascension (474; 475).
Bioko (350).
Canaries (2; 5; 8; 12; 13; 70; 71; 226; 229; 230; 301; 489; 490).
Côte d'Ivoire (287; 288).
Gabon (282; 284).
Ghana (292; 299; 344; 376; 377; 491).
Guinée (287).
Liberia (129).
Mauritanie (529).
Namibia (36B; 348; 522).
Salvage Islands (38B; 231; 555).
Sénégal (59; 182; 282; 399; 411).
Sierra Leone (295).
Togo (293).
Western Sahara (349).

Note. Santos (489) identified two species of *Ceramium* from the Canaries, one (which could be *C. echionotum*) with unicellular spines, the other one spineless. Most of the above records seem to have involved more than one species; Jardin (282; Gabon) mentioned two species, as did John & Lawson (293 and 295), from Togo and Sierra Leone, respectively. In both the latter cases, specimens resembling *Ceramium codii* (Richards) G. Mazoyer were included in the recording. Naegelé (411) referred to 'plusieurs espèces de *Ceramium*'. Wynne (36B) debated at considerable length the similarities and differences between various named taxa and his material.

Chaetangium erinaceum (Turner) Papenfuss

Note. See *Nothogenia erinacea* (Turner) Parkinson. The latter author (1983) should be consulted in regard to the present situation with the nomenclature and status of the generic concepts involved.

Chaetangium magnificum Pilger
See *Nothogenia magnifica* (Pilger) J. Price, **comb. nov.**
Basionym: *Chaetangium magnificum* Pilger in *Hedwigia* **48**: 181, taf. VII fig. *C*, 1–3 (1908).

Chaetangium ornatum (L.) Kützing [or simply Kützing]
See *Nothogenia erinacea* (Turner) Parkinson and the note to *Chaetangium erinaceum*.

Chaetangium ovale (Suhr) Papenfuss
See *Nothogenia ovalis* (Suhr) Parkinson and the note to *Chaetangium erinaceum*.

Champia compressa Harvey
See the entry for *Champia vieillardii* Kützing.

Champia lumbricalis (L.) Desvaux
Namibia (348; 437; 522; 523).
'Luderitz [Namibia] to Danger Point [South Africa]' (523).

Note. Citation of authorities as (Roth) Desvaux, as for example in Seagrief (1984), seems to be based on common usage following Kylin. Apart from the complications introduced by use of the name *Mertensia* (the basionym genus, if Roth is accepted), the latter author cited Linnaeus's *Mantissa* . . . (1771: 311) in synonymy of his *Mertensia lumbricalis*, as well as the Reichard edition of *Systema Plantarum* **4**: 583. Roth deduced in his description what he thought were septal and fructification differences between the Linnaean description and the characteristics of Thunberg material that he (Roth) had in hand. Linnaeus's description was based on Koenig 40, material from the Cape of Good Hope, this latter also being the origin of Roth's Thunberg specimens. Despite the deduced differences, Roth's localisation statement still included: 'Ad Promontorium bonae spei observarunt *Thunberg* et *Koenig*.'

Champia parvula (C. Agardh) Harvey
Angola (298; 352).
Ascension (37).
Cameroun (288; 337; 350; 537).
Canaries (12; 13; 16; 38B; 38D; 70; 108; 128A; 191; 225; 226; 227; 229; 235; 306B; 379; 392; 489; 490; 556).

Cape Verde Islands (38B; 38D; 556).
Côte d'Ivoire (288; 350).
Ghana (299; 350; 376; 491).
Mauritanie (38B; 38D; 349; 556).
Príncipe (?93; 288; 350; 535).
Salvage Islands (38B; 38D; 231; 556).
São Tomé (93; 288; 350; 535).
Sénégal (529).
Western Sahara (38B; 38D; 349; 556).
'Atlántico (de Inglaterra a Canarias)' (517).
'Atlantique nord (de l'Angleterre aux Canaries)' (189).
'Cosmopolite/subcosmopolite' (529).
'Warm parts of the Atlantic' (375).
'widely reported from warmer parts of the Atlantic . . . but species limits are at present ill-defined' (273).
'widely spread in warmer waters' (535).
'widespread from boreal-antiboreal to tropical seas' (350).
[As *Champia parvula* Harvey]
Canaries (547).
Cape Verde Islands (38).
'D'Angleterre à Madère et aux Canaries' (89).
'De l'Angleterre aux Canaries' (38).
[As *Lomentaria parvula* Agardh]
Cape Verde Islands (145).
[As *Lomentaria pygmaea* Gaillon]
Canaries (401).

Note. As indicated in Irvine (273), problems with recognition of species limits may well colour the pattern of distributional reports. Clearly Jaasund (280: 405) had arrived at a similar conclusion in stating: 'it must be said that this species seems to be variously understood by different contributors to the herbaria'. Doubt as to determination seems also to have affected Carpine's (93) statement for Príncipe. Attribution here of Montagne's (401: 156) Canaries record is based on Børgesen's (70: 92–3) conclusion after examining a Montagne specimen of '*Lomentaria pygmaea*'. Note that this is one of the three species (with *Ceramium tenuissimum* and *Gracilaria disputabilis*, q.v.) for which Sourie's (529) collections provided authentic first reports for Sénégal.

Champia salicornioides Harvey ['*salicornoides*']
Ghana (292; 299; 300; 350; 376; 377; 491).
Sénégal (59; 122; 182; 292).
'This record [Ghana] is the first for West Africa and . . . suggests that it might be of pantropical distribution' (292).
'warm temperate and tropical parts of the Atlantic' (292).
'widespread in many warm temperate and tropical seas' (350).

Note. All renderings as '*salicornoides*' are here treated as though the radical terminal 'i' had been employed. The statement in John & Lawson (292) was employing the term 'West Africa' in the restricted sense of the Gulf of Guinea area. Dangeard (122) was not entirely convinced of the identity of his material, indicating what he regarded as differences in the overall form of the plants and in the branching pattern.

Champia tripinnata Zanardini
Pagalu (456; 457; 535).
Príncipe (350; 535).
'in the eastern tropical Atlantic Ocean and the Red Sea' (350).

Champia vieillardii Kützing
Ghana (286; 292; 299; 350; 376; 377; 491).
'probably widespread in tropical seas' (350).

Note. There has been long-standing confusion between this species and *Champia compressa* Harvey, such that it is difficult to be sure of the realities of world distribution. The suggestion that it might be widespread in tropical seas derives from additional recordings in Viet Nam and East Africa. Simons (523) recorded *Champia compressa* Harvey from southern Africa (Cape Peninsula to Delagoa Bay).

Champia spp.
Angola (352).
Ascension (474).
Ghana (487).
Sénégal (55; 182; 399; 531).
Note. For their Sénégal record, G. Feldmann & Bodard (182) observed of the genus and possible species involved: '*Champia* sûrement différent de *Champia parvula* (C. Ag.) Harv.'

Chantransia mollis Pilger
See *Audouinella saviana* (Meneghini) Woelkerling.

Chantransia naumanni Askenasy
See *Audouinella naumannii* (Askenasy) J. Price.

Chantransia saviana (Meneghini) Ardissone
See *Audouinella saviana* (Meneghini) Woelkerling.

Cheilosporum
It seems likely that at least the southern parts of the checklist area are woefully locally under-recorded for this genus. Seagrief (1984) listed some 14 taxa in the genus for South Africa; even allowing for re-allocation of a substantial proportion of these taxa to *Arthrocardia*, this leaves many more than the current single species that is apparently legitimately recorded for the present area.

Cheilosporum acutilobum Decaisne
Mauritanie (541).
Note. This record represents an error of geographical attribution; the specimens being referred to by Tittley et al. (541) as in BM in fact derive from Mauritius.

Cheilosporum elegans (J. Hooker & Harvey) Areschoug in J. Agardh
Cape Verde Islands (38).
[As *Cheilosporum elegans* Harvey]
Cape Verde Islands (408).
Note. Also recorded (see Seagrief, 1984) from South Africa, which with the location of the original material (New Zealand) creates an oddly disparate distribution pattern, if true.

Chondria bernardii P. Dangeard ['*bernardi*']
Ghana (292; 299; 350; 376).
Sénégal (59; 120; 122; 529).
'in warm temperate and tropical parts of the eastern Atlantic Ocean' (350).
Note. Seems likely to be more widespread, from the summary statement in Lawson & John (350).

Chondria capensis (Harvey) Falkenberg
Angola (352).
Namibia (36B; 348; 352; 487; 500; 522; 523).
'Swakopmund [Namibia] to Hermanus [South Africa]' (523).
[As *Chondria capensis* (Harvey) J. Agardh]
Namibia (128; 158).
Note. The record in Dinter (158) is original, representing his own collecting from Walfischbai; save for records presented by Simons (522), all other reporting for Namibia is secondary. J. Agardh (26: 802–803) transferred the species to his *Chondriopsis*.

Chondria coerulescens (J. Agardh) Falkenberg
Canaries (227).
[As *Chondria coerulescens* J. Agardh]
Canaries (16; 225).

[As *Chondria caerulescens* J. Agardh]
Canaries (489).
[As *Chondria coerulescens* (Thuret) Falkenberg]
Sénégal (529).

Note. Neither of the above locations is wildly unlikely, since most generalized statements of distribution refer to 'England to Morocco' (as, e.g. in Ardré, 33: 223). Some doubt remains as to presence in Sénégal, however, since Sourie himself (529) considered the determination to be sufficiently doubtful to be recorded with '?'.

Chondria confusa G. W. Lawson & D. John
See *Chondria dangeardii* Dawson

Chondria curvilineata Collins & Hervey
Salvage Islands (38B; 556; 556A).

Note. Weisscher (556: 62) commented on the record in terms indicating the finding of only a single specimen, from Selvagem Pequeña, that agreed with descriptions by Collins & Hervey (106: 120–121) and Taylor (540: 617). The significance of the find, and the likelihood of material from elsewhere in the list area, remain problematical.

Chondria dangeardii Dawson
Sénégal (123A).
[As *Chondria confusa* G. W. Lawson & D. John]
Ghana (350).
'In warm temperate and tropical parts of the Atlantic Ocean' (350).
[As *Chondria platyclada* P. Dangeard]
Ghana (299; 300; 376; 377).
Guinea-Bissau (529).
Sénégal (122; 529).

Note. Purely on nomenclatural grounds, *Chondria confusa* G. W. Lawson & D. John is a superfluous name since a perfectly correct renaming of this taxon as *C. dangeardii* Dawson was affected by E. Dawson (123A: 460). The matter of homogeneity of material throughout is no small assumption since (see 350: 327–328) Lawson & John were unable to examine Dangeard's original material. From the phraseology in Dawson's (123A: 460) entry, it seems that he also was working merely from published text and illustrations. As to material from the present area, Sourie (529: 116) repeated J. Feldmann's comment to him that specimens in his [Feldmann's] hands corresponded well with Dangeard's (122) description of *Chondria platyclada* from the Dakar (Sénégal) area. Unfortunately, *C. platyclada* Dangeard (1952) is a later homonym for W. R. Taylor's (1945) name for Pacific material. Since both Dawson himself (loc. cit.) and Cribb (113: 108) considered *C. platyclada* Dangeard to have been applied in the same sense as *C. dangeardii* Dawson, no further action nomenclaturally is required and we refer here the records under both *C. confusa* and *C. platyclada* Dangeard, pending comparison of all voucher material with the types of Dangeard's and Dawson's taxa.

Chondria dasyphylla (Woodward) C. Agardh
Canaries (38D; 71; 128A; 191; 226; 227; 392).
Sénégal (50; 399).
'Atlantique (de l'Angleterre aux Canaries)' (33).
[As *Chondria dasyphylla* C. Agardh]
Mauritanie (349; 516).
[As *Chandria* (sic!) *dasyphylla* (Woodward) Agardh]
Canaries (236).
[As *Chondria clasyphylla* (sic!) (Woods.) (sic!) Agardh]
Canaries (235).
[As *Chondriopsis dasyphylla* Woodward]
Canaries (439).

Note. Piccone (439) had only three young specimens seemingly referrable to this species; see his comments regarding the consequent doubts. The Mauritanie record in Lawson & John (349) derived solely and directly from the earlier record in Seoane-Camba (516).

Chondria densa P. Dangeard
Ghana (350).
Guinea-Bissau (529).
Sénégal (33; 120; 122; 529).
'In warm temperate and tropical parts of the eastern Atlantic Ocean' (350).
[As *Laurencia densa* (P. Dangeard) J. Feldmann]
Sénégal (193A).

Note. There has been debate, still unresolved, as to whether this taxon should really be attributed to the genus *Laurencia*, and as to the conspecificity of the species with *Laurencia microcladia* Kützing. In regard to the former, we have followed Ardré (33: 356 [or 223–224 in the reprint]) in considering the taxon as a *Chondria*. This, apart from appearing at present both biologically and taxonomically more accurate, avoids two additional complications. The first of these relates to the transfer by J. Feldmann (in J. & G. Feldmann, 193A) of *C. densa* to *Laurencia*; no full reference to the original publication by Dangeard is given, even the year of citation, 1952, relating to the second (122 in our list) of two papers in which the species was treated by its author, not the first (120 in our list). The second problem by-passed is the possible conspecificity of *C. densa* P. Dangeard with *Laurencia microcladia*, a possibility introduced by Bodard (54) for at least the understanding of the concept behind his own application of *L. microcladia* Kützing to material from Sénégal. Referring to *Laurencia microcladia*, Bodard stated after that name '(= *L. densa* J. Feldm., = *Chondria densa* Dangeard)'. As often with Bodard's work, no further justifying information is presented, leaving a somewhat open position. The alternative possibility, that the whole concept and material behind *L. microcladia* Kützing should actually refer to a *Chondria*, appears unlikely but not impossible; a further study is required, although some authors (e.g. Cordeiro-Marino, 108) have already made it clear that they believed the taxon legitimately to represent, and therefore to belong in, *Laurencia*.

Chondria muscoides (L.) C. Agardh [or simply C. Agardh]
See *Acanthophora muscoides* (L.) Bory.

Chondria nana C. Agardh
See *Chylocladia reflexa* Lenormand.

Chondria platyclada P. Dangeard
See *Chondria confusa* G. W. Lawson & D. John.

Chondria ramulosa Lindenberg
See the entries for *Acanthophora muscoides* (L.) Bory and *A. ramulosa* Lindenberg ex Kützing.

Chondria scintillans G. Feldmann
Mauritanie (181; 349).
Sénégal (59).
'Atlantique (de la Bretagne à la Mauritanie)' (33).

Note. Lawson & John (349) did not themselves collect material of this species; their record is based on data in Ardré (33) and Feldmann (181). *Chondria scintillans* is stated closely to resemble *C. dasyphylla*, although distinct from it.

Chondria tenuissima (Goodenough & Woodward) C. Agardh
Canaries (38B; 38D; 71; 128A; 191; 226; 227; 232B; 292; 306B; 375; 379; 392; 517; 555; 556).
Gambia (296; 350).
Ghana (292; 299; 300; 350; 376; 377; 491).
Salvage Islands (38B; 38D; 71; 215; 216; 231; 375; 555; 556).
Western Sahara (38B; 38D; 349; 555; 556).
'Atlantique (de l'Angleterre au Rio de Oro . . .)' (33).
'Atlantique: depuis les côtes anglaises jusqu'au Rio de Oro' (222).
'Atlantique et subtropical' (190).
'Nordwestafrika' (499).
'probably widespread in warm temperate and tropical seas' (350).
'West coast of Europe from Great Britain southward to N. Africa' (375).
[As *Chondria tenuissima* (Goodenough & Woodward) C. Agardh f. *subtilis* Kütz. f.]
Canaries (71).

Note. Lawson & John's (349) statement is based on those in Ardré (33) and Gayral (222); they did not collect material of the species.

Chondria uvaria (Wulfen) C. Agardh
See *Botryocladia botryoides* (Wulfen) J. Feldmann.

Chondria sp. A
Ghana (350).

Note. See Lawson & John (350) for a statement of distinctions from other *Chondria* spp., including 'sp. B'.

Chondria sp. B
Ghana (350).

Note. See Lawson & John (350) for a statement of distinctions from other *Chondria* spp., including 'sp. A'.

Chondria spp.
Canaries (71).
Guinea-Bissau (529).
Mauritanie (336; 349; 529).
Namibia (312A; 348; 522).
São Tomé (93; 535).
Sénégal (52; 59; 411; 529; 542).

Note. Sourie (529) utilised the name '*Chondria* sp. *A*' for his records from Guinea-Bissau and Sénégal. In view of the duplication of this method of reference with that employed by Lawson & John (350) (see above entries), we have included Sourie's information here until such time as the detailed nature of the plants concerned is known.

Chondrus crispus Stackhouse
Canaries (89).
Cape Verde Islands (38; 500).
Ghana (?350).
Mauritanie (349).
'Atlantique, de la Norvège aux Canaries' (38).
'colder water . . . on the eastern side of the Atlantic as far south as . . . possibly Morocco and Cape Verde Islands' (350).
'possibly Morocco and Cape Verde Islands' (172).
[As *Chondrus crispus* (L.) Stackhouse]
Canaries (252).
Cape Verde Islands (100; 183; 191; 252; 499).
Mauritanie (252).
'Nordwestafrika' (499).
'Westafrika' (499).
[As *Chondrus crispus* (L.) Lyngbye]
Canaries (401).
Cape Verde Islands (408; 445; 446; 449).
[As *Chondrus crispus* Lyngbye]
Angola (261; 262).
[As *Chrondrus* (sic!) *crispus* Lyngbye]
Angola (261; 263).
[As *Chondrus crispus* var. *lonchophorus* Montagne Hb.]
Cape Verde Islands (38; 408).
[As *Fucus crispus* L.]
Ghana (271).

Note. There is considerable doubt about the majority of these records and many of the publishing authors have stated as much. For Cape Verde Islands, for example, Schmidt & Gerloff (500) commented [translation]: 'The occurrence of *Chondrus crispus* is more than doubtful – probably based on an erroneous determination.' By contrast, Feldmann (191: 426) examining specimens from the Cape Verde Islands, found good agreement with the anatomical structure of *Chondrus crispus*, but all the specimens were sterile and the absence of cystocarps did not permit definitive statement of determination – confirmation is still required. As regards Ghanaian records, the orginal basis is the statement in Hornemann (271); some aspects of the doubt here have been considered by Lawson & John (350). In fact, it is most unlikely that the nomenclatural equivalence of *Fucus crispus* L. with *Chondrus crispus* Stackhouse represents (or represented) the real presence of *C. crispus* in Ghana. Many years of collections have failed to reveal other specimens from along the Ghanaian coasts; consequently, clarification of the nature of the material recorded would require re-examination of P. E. Isert specimens, presumably in Copenhagen (C). There is a possibility that at least some of the Isert Ghanaian material was destroyed by fire in 1807.

Canary Islands records are very confused; even the original publishing author, Montagne (401), re-allocated the material to *Grateloupia dichotoma* J. Agardh (q.v.). The records are included here above simply for reference purposes. Confirmation of Montagne's redetermination was published by Børgesen (70) and by Ardré (33), both of whom referred to the date of Montagne (401) in error as 1840; '1841' is correct. The additional, but secondary, Canaries record in Benítez (44) is also attributed in this present text to *Grateloupia dichotoma*. Bornet (89) and Hariot (252), subsequent to Montagne, re-established records for the Canaries but, in view of the later comments by Ardré (33) and by Børgesen (70), supplemented by J. Feldmann's (191: 426) statement that *C. crispus* 'n'existe pas aux Canaries', the doubts remain. Lawson & John (349) did not detect material in Mauritanie, their listing being based directly on Hariot (252). Finally, the Henriques (261; 262; 263) records for Angola must surely be in grave doubt.

Chondrus elongatus Kützing
See *Chondrus elongatus* Montagne.

Chondrus elongatus Montagne
Cape Verde Islands (38; 145).

Note. Askenasy (38; 166–167) commented: 'Si c'est le *Ch. elongatus* Kütz. Tab. Phycol. XVII, t. 52, dont il s'agit ici, cette algue est d'après Kützing l.c.: Ahnfeltia elongata Mont., Syll. Crypt. p. 472, et d'après J. Agardh, Epicrisis, p. 213: Gymnogongrus vermicularis J. Ag.'. Dickie (145), who first applied this name to Cape Verde Islands material, based his determinations only on descriptions by Montagne, not seeing any authentic specimens. Thus, it is difficult without extended work to be certain of the nature of specimens recorded for these islands under that name. Simons (522) and Lawson & Isaac (348) provided the only authentic records otherwise available for the area – under *Gymnogongrus vermicularis* (C. Agardh) J. Agardh (q.v.), detected for widespread locations along the Namibian coastline. The latter is a southern African species, lacking records for further north along the coast.

Choreonema thuretii (Bornet) Schmitz
Canaries (9; 13; 38B; 38C; 38D; 226; 227; 555; 556).
Mauritanie (38B; 38C; 38D; 248; 252; 349; 359; 555; 556).
Salvage Islands (38B; 38C; 38D; 231; 375; 555; 556; 556A).
'Probably cosmopolitan' (375).

Note. Reports of bearing organism for records from the area include *Jania capillacea*, *J. corniculata*, *J. longifurca*, *J. rubens*, and *Corallina granifera*. See also *Choreonema* sp.

Choreonema sp.
Cape Verde Islands (366).

Note. Although no other published records have been traced for these islands under the full binomial, it is highly likely that, given correct generic determination, the basis for the Lemoine (366) statement would be material of *Choreonema thuretii*.

Chromastrum Papenfuss
See entries here placed under *Audouinella*. The circumscription of the genus, even in those areas (e.g. The Netherlands) where the custom of its acceptance is maintained, was tightened by Stegenga & Mulder (536: 301 et seq.) to apply only to 'species' possessing stellate chromatophores and a characteristic tetrasporophyte/gametophyte morphological alternation in the life-history. The overall complexity of the situation is exemplified by Stegenga & Mulder's own summarizing statement that the genus comprises at least 60 current 'species', including 25 gametophytes and 35 tetrasporophytes, which they suggest would be covered by 10–12 'true' species.

Chrysymenia bullosa Levring

Note. The relationship of Levring's (375) Madeira 'endemic' species, *Chrysymenia bullosa*, to the

Canaries reports of taxa in the genus is not clear. Levring suggested that his species was near *C. enteromorpha* Harvey (q.v.) from the American Atlantic coast (North Carolina), although that species is bigger and proliferate. *C. enteromorpha* Harvey has recently been reported from the Canaries and from Ghana.

Chrysymenia chiajeana Meneghini
See *Botryocladia chiajeana* (Meneghini) Kylin.

Chrysymenia dichotoma J. Agardh
See *Halymenia dichotoma* (J. Agardh) J. Agardh.

Note. De Toni (133: 547) commented '**Chrysymenia dichotoma** J. Ag. Sp. II, p. 211 est *Halymenia pinnulata* J. Ag. partim', although he later (134: 1540–41) placed '*Chrysymenia dichotoma* J. Ag. Sp. II: 211' in unqualified synonymy of '*Halymenia dichotoma* J. Ag., Epicrisis, p.136.' The records published by J. Agardh (24: 211) and by Hemsley (259) have therefore been attributed to *Halymenia dichotoma* (J. Agardh) J. Agardh, q.v., but it is by no means certain, without re-examination, that other taxa were not involved.

Chrysymenia enteromorpha Harvey
Canaries (18).
Ghana (18; 292; 299; 350).
'widespread in warm temperate and tropical seas' (292; 350).
[As *Chrysysmenia* (sic!) *enteromorpha* Harvey]
Ghana (377).

Note. All reports of this species are based on small numbers of specimens, for the present area. The first report for anywhere in West Africa (John & Lawson, 292), published as recently as 1972, was based on two collections only, from 10m depth on Vernon Bank, off the Ghanaian coast; the more recent record (1984) for the Canaries was based solely on a single small specimen from 25m depth, south of Montaña Clara, an islet north of Lanzarote. Afonso-Carrillo et al. (18: 40) indicated: 'las Islas Canarias son su nuevo límite septentrional en el Atlántico Oriental.' Possibly the fact that the species seems, at least predominantly, to occur only in the fairly deep subtidal has led to previous failure of detection. See also the entries for *Chrysymenia bullosa* Levring and *Botryocladia senegalensis* G. Feldmann & Bodard.

Chrysymenia uvaria (Wulfen) J. Agardh (*seu auct.*)
See *Botryocladia botryoides* (Wulfen) J. Feldmann.

Chrysymenia ventricosa (Lamouroux) J. Agardh
'Atlantic Ocean (European and African coasts, Canary Islands . . .)' (177).

Note. The validity of this statement requires critical scrutiny; the strong possibility exists that there has been confusion with other taxa in *Botryocladia* or in *Chrysymenia*. The nearest records published for African shores are from Tunisia (392), Egypt (392), and Tangier (189: 89–90).

Chylocladia albertisii Piccone
See *Coelarthrum albertisii* (Piccone) Børgesen.

Chylocladia capensis Harvey
Namibia (348; 522).

Note. For a probable earlier record of the same taxon from the same area, see the entry for *Lomentaria patens* Kützing.

Chylocladia cliftonii Harvey
See *Coelarthrum albertisii* (Piccone) Børgesen.

Chylocladia kaliformis (Goodenough & Woodward) W. Hooker (*seu auct.*)
See *Chylocladia verticillata* (Lightfoot) Bliding.

Chylocladia ovalis (Hudson) W. Hooker
See *Gastroclonium ovatum* (Hudson) Papenfuss.

Chylocladia reflexa Lenormand in Desmazières [or (Chauvin) Zanardini]
See *Gastroclonium reflexum* (Chauvin) Kützing.

Chylocladia squarrosa (Kützing) Le Jolis
'Atlantique (de la Suède aux Canaries)' (33; 189).
[As *Chylocladia squarrosa* Le Jolis]
'De la Suède aux Canaries' (89).

Note. There is mounting evidence that plants to which this name has hitherto been applied may more accurately be placed in one of two closely related species. Small epiphytic plants often grow with, are identified as, and may actually be, *Champia parvula* (C. Agardh) Harvey; even then, however, the real identity of the material may be *Chylocladia verticillata* (Lightfoot) Bliding, in the juvenile form retaining at the time its short solid stipe. Larger plants to which this name has been given have whorls of laterals closely set together and patent, and these may well be growth forms of *C. verticillata* developing under particular conditions of light, temperature and other physical parameters. To what extent this is fully established as totally invalidating the taxon wherever the name has been used is not clear. The frequency of name application in the southern part of the cited range (i.e. the northern part of the list area) is in any case low; even Ardré (33) only found the 'species' once, on sandy covered lower intertidal rocks in Portugal.

Chylocladia verticillata (Lightfoot) Bliding
Canaries (13; 33; 38D; 227; 273; 392).
Sierra Leone (350).
'Atlantique (de la Norvège aux Canaries)' (33).
[As *Chylocladia kaliformis* (Goodenough & Woodward) Hooker]
Canaries (70; 191; 517).
Sierra Leone (30; 350).
'Atlantico de Suecia y Noruega a Canarias' (517).
'From Sweden southwards to the Canary Islands' (70).
[As *Chylocladia kaliformis* Hooker]
'De Suède aux Canaries' (89).
[As *Chylocladia kaliformis* (Goodenough & Woodward) Greville]
'Atlantic Ocean (from Sweden to Canary Islands)' (177).
'Atlantique nord (de la Suède aux Canaries)' (189).
[As *Gastroclonium kaliforme* (Goodenough & Woodward) Ardissone]
Canaries (132; 239).
'von den Canarischen Inseln bis Norwegen.' (239).
[As *Lomentaria kaliformis* (Goodenough & Woodward) Gaillon]
Canaries (25; 26; 401).
[As *Lomentaria kaliformis* Gaillon]
Canaries (44).

Note. The record from Sierra Leone, first published by Aleem (30), was repeated in Lawson & John (350), but with considerable doubt as to its validity. Apart from the general doubt in that situation, Aleem seems only to have had available a single specimen, from the lower littoral at Lakka, Sierra Leone peninsula. The earliest record from the Canaries, in Montagne (401), appears to have been the sole or major basis for the statements in Børgesen (70) and in Ardré (33). See also the comments in the entry for *Lomentaria patens* Kützing, as well as the note to *Chylocladia squarrosa* (Kützing) Le Jolis.

Chylocladia sp.
Guinea-Bissau (?529).
Namibia (348; 522).
Sénégal (529).

Note. Sourie's (529) expressed doubt related to the validity of determination. The record in Lawson & Isaac (348) is based directly on data from Simons (522).

Coelarthrum albertisii (Piccone) Børgesen
Canaries (64; 70; 71; 106; 139; 191; 226; 227; 328; 496; 538).
[As *Chylocladia albertisii* Piccone]
Canaries (?132; 439).

Note. Piccone (439) had only 'Un solo esemplare, e sterile' to work with. He indicated the taxon to be, on external characteristics, rather similar to *Chylocladia [Coelarthrum] cliftonii* Harvey, but much smaller, and of different internal structure. Frond articulation distinguishes the present taxon from other species in the section. The doubt expressed by De Toni (132: 582) related to his placement of the taxon in 'Species incertae aut tantum nomine mihi cognitae', commenting 'Forsan *Lomentaria* species'.

Coelothrix indica Børgesen
See the entry for *Coelothrix irregularis* (Harvey) Børgesen.

Coelothrix irregularis (Harvey) Børgesen
Ascension (475).
'world-wide . . . on tropical to warm temperate coasts' (267A).

Note. Despite the paucity of recording from the present area, the statement reproduced above from Hoek (267A) may well be justified. Taylor (540: 488–89) recorded the species very widely in the Caribbean and tropical Atlantic, whilst Ginsburg-Ardré & Palminha (1964: 325–331) added localities in the Indian Ocean, South Pacific, and south Portugal (Faro-Olhao). Mainland East Africa (Tanzania) and Zanzibar were recorded by Jaasund (280: 406), referring at the same time to reports for the Marshall Islands by Yale Dawson. *Coelothrix indica* Børgesen (Mauritius) was accepted by both Dawson and Jaasund as conspecific with *C. irregularis*, a point also agreed by Ginsburg-Ardré & Palminha (1964). Apparently-antedating epithets (*rigens*; *radicans*) were shown by these latter authors to relate to other genera and species, whilst common confusion with *Wurdemannia setacea* and *Gigartina acicularis* (q.v.) was referred to by Taylor (540) and by Ginsburg-Ardré & Palminha (1964). Possibly previous recording has been restricted due to overlooking of *C. irregularis* amongst the widespread *Wurdemannia/Gigartina acicularis*.

Colaconema
For taxa hitherto combined by any authors in this genus, see entries under *Audouinella*.

Compsothamnion thuyoides (J. E. Smith) Schmitz
Canaries (227).
'Atlantique, de l'Angleterre aux Canaries' (196).
[As *Compsothamnion thuyoides* (Smith) Nägeli var. *thuyoides*]
'Atlantique (de l'Angleterre aux Canaries)' (33).
[As *Compsothamnion thuyoides* (Smith) Nägeli]
Canaries (190; 191; 375).
Salvage Islands (38B; 231).
'Atlantique, de l'Angleterre aux Canaries' (190).
[As *Callithamnion thuyoides* J. Agardh f. *breviarticulata*]
Canaries (71; 439).

Note. For the Canaries, Børgesen (71) merely repeated Piccone's (439) record, having not even seen the specimens concerned. Piccone's original report was based on Liebetruth's collections. For the relatively nearby Madeira, Levring (375) recorded both *Compsothamnion thuyoides* (Smith) Nägeli and *C. gracillimum* (Harvey) Nägeli, but neither very frequently.

Conferva pallescens Bory
See *Spyridia filamentosa* (Wulfen) Harvey.

Conferva villum C. Agardh
Canaries (219; 401).

Note. The record in Gaudichaud (219) actually states 'circa insulas Teneriffam et Rawak.' The overall details are merely repeated in Montagne (401). See also the entries for *Polysiphonia villum* C. Agardh/J. Agardh, for *Lophosiphonia villum* (J. Agardh) Setchell & Gardner, and (especially) for *Polysiphonia scopulorum* var. *villum* (J. Agardh) Hollenberg. It is likely that, from stated opinions and standard nomenclatural equivalence, the report constitutes a record falling within the modern concept covered by the latter name. The descriptions in the early reports, taken literally, leave some doubts – the details call to mind the genus *Audouinella*. For the reported substrate organism ['zoophyta fruticulosa (galaxaura)'], see the entries for *Galaxaura fruticulosa* (Ellis & Solander) Lamouroux and *G. lapidescens* Lamouroux.

Corallina adhaerens (Lamouroux) Kützing
See *Jania adhaerens* Lamouroux.

Corallina berterii Montagne in Harvey
Mauritanie (349).
Western Sahara (349).

Note. There is some measure of doubt as to the more correct citation of authorities. Some (e.g. Seagrief, 1984: 19) prefer to employ 'Montagne *ex* Harvey'. We believe that Harvey most probably took the Latin diagnosis from data written by Montagne (and taken from his then unpublished *Flora Chilensis*) on a specimen sheet which he subsequently sent to Harvey and is now in Trinity College, Dublin. This specimen is firmly indicated in the original description. Hence, we employ the preferred and probably more accurate 'Montagne *in* Harvey'.

Corallina capensis Leach in Decaisne
See the entry for *Corallina officinalis* L.

Corallina carinata Kützing
See *Arthrocardia carinata* (Kützing) Johansen in Seagrief.

Corallina cubensis (Montagne ex Kützing) Kützing
See *Haliptilon cubensis* (Montagne ex Kützing) Garbary & Johansen.

Corallina deshayesii Montagne
Salvage Islands (231).

Note. This name may well be a synonym of *Corallina mediterranea* Areschoug in J. Agardh. Gil-Rodriguez et al. (231) certainly so treated it. The information is reproduced in this list as a simple statement of the report under both species headings, pending resolution of the position of *C. mediterranea*, recently considered by many authors (231; 392; Boudouresque et al., 1984) to be a synonym of *Corallina elongata* Ellis & Solander (q.v.).

Corallina elongata Ellis & Solander
Canaries (8; 9; 13; 38D; 128A; 226; 227; 253; 306B; 379; 392; 541).
Mauritanie (253).
Salvage Islands (231; 541).
'Atlántico Oriental (Inglaterra – Mauritania)' (253).
[As *Corallina mediterranea* Areschoug in J. Agardh]
Canaries (3; 13; 16; 70; 89; 107; 191; 214; 225; 229; 237; 252; 304; 359; 386; 439; 489; 490; 499; 517; 546).
Mauritanie (252; 359).
Salvage Islands (231).
Sénégal (Casamance) (99; 350).
Sénégal (50; 59; 252; 349; 513).
Western Sahara (349; 476).
'Nordwestafrika' (499).
'Atlántico (del sur de Inglaterra a Canaries)' (517).
'Atlantique (de la Bretagne à la Mauritanie)' (33).
'Atlantique: depuis Brest jusqu'en Mauritanie' (222).
'depuis le sud de l'Angleterre jusqu'à l'île Madère et les Canaries' (356).
'Du sud de l'Angleterre aux Canaries' (89).
'from south of England southwards to the Canary Islands' (70).
'From warm temperate to tropical parts of the eastern Atlantic Ocean' (352).
[As *Corallina mediterranea* Areschoug]
Canaries (314; 547).
Mauritanie (349).
Salvage Islands (38B; 231).
Sénégal (Casamance) (99).
Western Sahara (349).
'Atlantique (du sud de l'Angleterre aux Canaries)' (188).
[As *Corallina deshayesii* Montagne]
Salvage Islands (231).
[As *Corallina microptera* Montagne]
Canaries (89; 403; 407).

Note. On the subject of the synonymy of *Corallina mediterranea* with *C. elongata*, see (amongst others)

Boudouresque et al. (1984: 46), Gil-Rodriguez et al. (231), Meñez & Mathieson (392: 36–37). There has always been much difference of opinion regarding the limits and relationships of *C. mediterranea*. Apart from the above synonymy, for instance, *C. mediterranea* has often been variously associated with *C. officinalis* L. (q.v.), *C. squamata* Ellis & Solander [= *Haliptilon squamatum*, q.v.], and *C. granifera* Ellis & Solander (q.v.). See Levring (375: 69) for the latter. Audiffred & Weisscher (38B: 33) stated unequivocally of *Corallina mediterranea* '= *Corallina officinalis* L.', but whether as regards the local pattern of Salvage Islands recording alone, or as regards the whole concept, was not entirely clear. No great consistency of opinion has existed within individual country traditions of naming, either. Apart from the recent opinion of Boudouresque et al. (see above), for example, French attitudes to the matter have varied between the extremes of: (i) Bornet (89: 190 [350]), who indicated for North Africa that *C. mediterranea* was 'assez distincte de . . . [*C. officinalis*] dans quelquesunes de ses formes, [mais] ne s'en sépare pas toujours avec toute la netteté désirable'; (ii) Bodard (50: 85), who reversed the approach and made the curious statement regarding his Sénégal material that '*C. squamata* [*H. squamatum*] . . . n'est d'ailleurs à notre avis qu'une forme de *C. mediterranea*'. Thus, opinions have often depended on where, or on material from which geographical area, the work was being done. The area concerned has often more directly, through tradition, determined the naming process. Børgesen (70) called his Canaries material *C. mediterranea* rather than *C. officinalis* simply on the grounds of general appearance and because '*C. mediterranea*' had a more southerly distribution. Afonso-Carrillo et al. (18: 46) went even further, in considering that the whole history of the recording of *C. officinalis* in the Canaries was in doubt and its presence therefore required confirmation. Lawson & John (349) concluded that the Cap Vert area of Sénégal represents a transition area, between warm temperate and tropical (Gulf of Guinea) regions, where for example *Corallina mediterranea* reached its southern limit.

Corallina microptera Montagne is included here on the basis of comments by Bornet (89: 130 [350]) that 'Le *C. microptera* Montg., des Canaries, n'est qu'une petite forme de cette espèce [*C. mediterranea*]'.

All these forms, with the sole exception of the now-transferred *Haliptilon squamatum* (q.v.), have at least proved to be *Corallina* in generic attribution; Garbary & Johansen (1982: 212), using the SEM, found that the surface morphology and trichocytes of *H. squamatum* were of the *Jania rubens* type, those of all the others being of the *Corallina officinalis* type.

In view of the conceptual confusions that have clearly and continually bedevilled species-limit recognition and application of names in this group of species, it is entirely possible that some of the attribution of records throughout conceals error in species determination of area records.

Corallina granifera Ellis & Solander
Canaries (5; 9; 13; 38B; 38D; 70; 89; 128A; 188; 191; 226; 227; 232B; 253; 306B; 359; 379; 483; 489; 498; 499; 517; 555; 556).
Cape Verde Islands (483).
Salvage Islands (38B; 38D; 555; 556; 556A).
'Nordwestafrika' (499).
'Atlántico oriental (Inglaterra-Canarias)' (253).
'Atlantique (. . . Canaries . . .)' (33).
'Mediterranean Sea and adjacent part of the Atlantic Ocean' (70).
'Mittelmeer und angrenzende Teile des Atlantischen Ozeans' (498; 499).
[As *Corallina granifera* Kützing]
Canaries (356).
[As *Jania granifera* Decaisne]
Canaries (216; 547).
Salvage Islands (215; 216).

Note. There is doubt as to the way in which this name has been applied by different authors for the parts of the area, aside from other conceptual problems. On the latter, Weisscher (555; 556) considered *Corallina granifera* easily distinguishable from *C. officinalis*, thus disagreeing with Levring (375: 69), who was convinced that several 'species' of *Corallina* were all forms of *C. officinalis* (q.v.). Amongst these 'species', he included *C. granifera* and *Corallina squamata* Ellis & Solander. Although extreme and not fully accepted, the suggestion is interesting in the light of the way names, not always legitimately, have been applied without reference back to type material.

There is some doubt, also, as to the correct identification of the material that forms the type of *Corallina granifera* Ellis & Solander (L. M. Irvine, pers. comm.), although the application of that name in terms of routine determination of record material has normally involved specimens correctly to be called *Haliptilon virgatum* (Zanardini) Garbary & Johansen [*Corallina virgata*]. Because of the potential difference between nature of type specimens and manner of application, we have maintained the entry for *C. granifera*, but it should be clearly understood that, for most practical purposes, the records established can be viewed as merely adding to the single overall distribution pattern for *Haliptilon virgatum* (q.v.).

Corallina lobata Lamouroux
Canaries (17; 25; 125; 128A; 134; 253; 318; 331; 332; 541).

Note. It is not clear as to what is the relationship, if any, between the present taxon and '*Arthrocardia lobata* Montagne' (q.v.). Mention of the latter by Montagne in connection with his *Corallina microptera* was incidental and seems not subsequently to have been further developed. At first sight, both 'taxa' would be expected to have a common basis, but neither name has been much invoked subsequently and all authors post-Lamouroux have failed to notice, or have ignored, Montagne's brief comment. For *C. lobata* Lamouroux, De Toni (134: 1853) suggested 'An eadem ac *C. rubens*?' which is, in any case, *Jania*, purely on current notions of generic placement. Unfortunately, the only available good evidence suggests that such a postulated relationship is wrong, since Garbary & Johansen (1982: 212) established that surface morphology and trichocytes of the type specimen of *C. lobata* Lamouroux are both of the *Corallina officinalis* type.

Corallina longifurca Zanardini
See *Jania longifurca* (Zanardini) Zanardini.

Corallina mediterranea Areschoug in J. Agardh
See *Corallina elongata* Ellis & Solander.

Corallina microptera Montagne
See *Corallina elongata* Ellis & Solander.

Corallina millegrana Lamarck
Canaries (125).

Note. This combination seems completely to have been ignored in phycological circles and our reasoned reaction was, therefore, after consulting colleagues working on the corallines, that we were probably dealing with colonial animal material. However, Garbary & Johansen (1982: 212) recently examined the surface morphology of the type of *Corallina millegrana* Lamarck and found the material definitely to be of the *Corallina officinalis* type. The entry is therefore maintained pending further clarification.

Corallina muscoides Kützing
Senegambia (134; 296; 319; 482).

Note. In general, geographical statements utilising this older area name can be taken, in the absence of precise locations, to indicate records for both Gambia and Sénégal (unless, that is, there is further reason to doubt the veracity for one or other country). Of the records above, all date back to Kützing's original statement 'Ad oras occidentales Africae (Senegambia).' (319). De Toni (134: 1854) commented: 'An cum *Corallina granifera* cognata?' It is doubtful that De Toni's suggestion will stand, since this would indicate that by naming practice the nature of the material would usually be *Haliptilon virgatum* (Zanardini) Garbary & Johansen. The latter authors (1982: 212) examined the surface morphology of the type of *C. muscoides* Kützing and found it to be of the *Corallina officinalis* type.

Corallina officinalis L.
Angola (541).
Canaries (13; 18; 38; 38C; 38D; 70; 74; 90; 225; 226; 227; 229; 230; 236; 304; 332; 375; 386; 387; 439; 499; 546; 547; 556).
Cape Verde Islands (38; 38C; 38D; 499; 556).
Ghana (541).
Mauritanie (38C; 38D; 349; 529; 556; 567).
Salvage Islands (38B; 38C; 38D; 215; 375; 439; 556).
Sénégal (38C; 38D; 50; 556).
Western Sahara (38C; 38D; 556).
'Nordwestafrika' (499).
'Westafrika' (499).
'Atlantique (de l'Arctique à la Mauritanie)' (33).
'Atlantique nord: jusqu'en Mauritanie' (222).
'De la Norvège aux Canaries' (38).

'Island bis Mauritanien' (567).
[As *Corallina officinalis* var. *mediterranea* Hauck]
Salvage Islands (231).
[As *Corallina*]
Canaries (548).

Note. The whole topic of the occurrence of this species in the list area is fraught with problems and disagreement. Most of the available comments concern the island groups, especially the Canaries, towards the northern boundary of the area. Perhaps the earliest firm comment is that in Askenasy (38: 175), who added to his entry a terminal note quoting remarks made by Bornet on the material being submitted to him. These remarks included: 'your species closely approaches *C. officinalis*. This species occurs in the Canaries. But it [your species] agrees better with *Corallina capensis* [Leach in Decaisne], which is considered, I am not sure why, an *Arthrocardia*, although it differs so little from *C. officinalis* that I have great difficulty distinguishing them.' See *Arthrocardia capensis* (Leach in Decaisne) Areschoug in J. Agardh. Levring (375: 69), inter alia, considered many taxa to be synonymous because of the existence of intermediate states; that view is detailed in the notes to *Corallina elongata* Ellis & Solander, of which *C. mediterranea* is currently considered a synonym. The latter was unequivocally stated to be a synonym of *C. officinalis* by Audiffred & Weisscher (38B: 33) – *but* see the reservations expressed under *C. elongata*. The tendency to name things according to local custom was shown by Børgesen (70: 69), who commented that Piccone's (439) records for the Canaries were most probably really *Corallina mediterranea* Areschoug, although he had not actually seen Piccone's specimens. Afonso-Carrillo et al. (18: 46) considered that the whole history of recording of *C. officinalis* from the Canaries was in doubt and its presence on the island group required confirmation. Thus, the identity of the material on which *all* these records are based for the present entry may well need re-assessment in the light of the opinion expressed by Afonso-Carrillo et al. The implication is that the whole content of the entry should perhaps appear under *Corallina elongata* Ellis & Solander.

Corallina palmata (Ellis & Solander) sensu Dangeard (122)
See *Corallina* spp.

Corallina pilulifera Postels & Ruprecht
Côte d'Ivoire (287; 288; 350).
Gambia (296; 350).
Ghana (288; 350).
Liberia (287; 288; 350).
'probably pantropical' (350).

Note. The absence of other records for western Africa probably derives from the still unresolved problems and difficulties of taxonomy in the genus *Corallina*, and the consequent inconsistencies and area variations in name-application. See the entries for *Corallina elongata* and *Corallina officinalis* for additional background and statements of similar problems elsewhere in the genus.

Corallina rubens *auct.*
See *Jania rubens* (L.) Lamouroux.

Corallina squamata Ellis & Solander [*seu auct.*]
See *Haliptilon squamatum* (L.) Johansen, L. Irvine & Webster, and the entries for *Corallina elongata* Ellis & Solander, *C. granifera* Ellis & Solander, and *C. officinalis* L.

Corallina subulata Ellis & Solander
See *Haliptilon subulatum* (Ellis & Solander) Johansen.

Corallina tenella Kützing [*seu auct.*]
See *Jania tenella* Kützing.

Corallina virgata Zanardini
See *Corallina granifera* Ellis & Solander and *Haliptilon virgatum* (Zanardini) Garbary & Johansen.

Corallina sp. A
Guinea-Bissau (529).
Sénégal (529).

Corallina spp.
Angola (352).
Canaries (5; 29; 67; 71; 229; 237; 301; 302; 304; 314; 351; 490; 545).
Cape Verde Islands (411).
Ghana (567).
Mauritanie (529).
Namibia (36B; 348; 522).
St Helena (533).
Sénégal (50; 411; 529; 530).
'West Africa' (290; 344).
[As possibly *Corallina palmata* (Ellis & Solander)]
Sénégal (122).
[As *Corallina* sp. (Cornicularíae)]
Ghana (487).
Namibia (348; 522).

Note. The Lawson & Isaac (348) records from Namibia are based solely on the data given by Simons (522). The statement in Round (487) for Ghana is a general one based on more specific information published at intervals by Lawson & John (various references). Sourie (529: 116) indicated that one of the species recorded as *Corallina* sp. was very common; at least one other species present amongst populations of the first was in much lower abundance in Sénégal. See the note in Wynne (36B) regarding similarities of his Namibian material to *Arthrocardia flabellata* (Kützing) Manza.

Corynomorpha prismatica (J. Agardh) J. Agardh
Ghana (290; 292; 299; 350; 376).
'in tropical parts of the Atlantic and Indian Oceans.' (350).
[As *Corynomorpha*]
Ghana (487).

Note. The record in Round (487) is a generalised statement based on more specific data in John & Lawson (292) and subsequently. As indicated in 292, the record was new for the Atlantic, being an apparent extension from the earlier recorded Indian Ocean distribution.

Corynospora furcellata (J. Agardh) Levring
See *Griffithsia arachnoidea* C. Agardh.

Corynospora pedicellata (J. E. Smith) J. Agardh
See *Monosporus pedicellatus* (J. E. Smith) Solier.

Cottoniella Børgesen
Considerable difference of opinion has existed recently over the recognition and limits of taxa in this genus. Schotter (513A) recognised the single species *Cottoniella arcuata* (Børgesen) G. Schotter emend. and within that four varieties: *algeriensis* G. Schotter, *euarcuata* G. Schotter, *fusiformis* (Børgesen) G. Schotter, *filamentosa* (Howe) G. Schotter. The latter two were recorded, on the basis of the earlier Børgesen work, from the Canaries. Feldmann (191: 415) commented that *C. fusiformis* was close to *C. arcuata* from the Antilles; he considered the four listed species all to be localized in the tropical Atlantic (Antilles, Brazil, Canaries) and that one other of them (which he did not name but clearly meant *C. filamentosa* as then recognised) occurred with *C. fusiformis* in the Canary Islands. In their earlier papers, the group of workers on the Canaries, principally led by Gil-Rodriguez, adopted Schotter's (513A) ideas and nomenclature, but latterly followed revisions advocated by Cormaci, Furnari & Scammacca (108A); these latter authors recognised *C. arcuata* Børgesen (not from the Canaries) and *C. filamentosa* (Howe) Børgesen, with vars *filamentosa* (Canaries), *fusiformis* (Børgesen) Cormaci, Furnari & Scammacca (Canaries), and *algeriensis* (Schotter) Womersley & Shepley (not from the present area). They added with some doubt *C. sanguinea* Howe (from Brazil; not recorded from this list area). Most recently (1985), Gil-Rodriguez and colleagues (232A) found the previously unknown sexual reproductive stages, and confirmed the details of tetrasporophytes (previously known only for the var. *algeriensis* of *C. filamentosa*), both these in *C. filamentosa*

var. *fusiformis* from the Canaries. We have accepted the taxonomy and nomenclature utilised by Cormaci et al. (108A) for the species entries which follow. For general discussion on relationships between *Cottoniella* and adjacent genera, see Abbott (1984).

Cottoniella arcuata Børgesen
See the general discussion on *Cottoniella* and entries for *Cottoniella filamentosa* (Howe) Børgesen var. *filamentosa* and var. *fusiformis* (Børgesen) Cormaci, Furnari & Scammacca.

Cottoniella filamentosa (Howe) Børgesen var. **filamentosa**
Canaries (108A).
[As *Cottoniella filamentosa* (Howe) Børgesen]
Canaries (71; 128A; 191; 236; 304; 375; 517).
[As *Cottoniella arcuata* (Børgesen) G. Schotter var. *filamentosa* (Howe *pro sp.*) G. Schotter]
Canaries (227; 513A).
[As *Cottoniella arcuata* (Børgesen) Schotter var. *filamentosa* (Børgesen) Schotter]
Canaries (226).
Note. See the general note to the genus *Cottoniella.*

Cottoniella filamentosa var. **fusiformis** (Børgesen) Cormaci, Furnari & Scammacca
Canaries (108A; 232A).
[As *Cottoniella fusiformis* Børgesen]
Canaries (16; 71; 72; 191; 225; 229; 230; 235; 237; 375; 489; 490; 513A).
Salvage Islands (556A).
Note. There is much printing error in many of the works recording the taxon for the Canaries under the name of *Cottoniella fusiformis* Børgesen; in Feldmann (191), for instance, the genus is rendered '*Gottoniella*', whilst Gonzalez (237) has the epithet printed as '*fusciformis*'.
[As *Cottoniella fusiformis* (Howe) Børgesen]
Canaries (236; 556).
Salvage Islands (556).
Note. As with the above sub-heading, so mis-spelling of names is rife here; Gonzalez (236), for example, shows the transferring author as 'Görgs.'!
[As *Cottoniella arcuata* (Børgesen) Schotter var. *fusiformis* (Børgesen) G. Schotter]
Canaries (12; 13; 38B; 38D; 227).
Salvage Islands (38B; 38D).
[As *Cottoniella arcuata* (Børgesen) G. Schotter var. *fusiformis* (Børgesen *pro. sp.*) G. Schotter]
Canaries (513A).
Note. See the general note to the genus *Cottoniella.*

Crodelia
The genus *Crodelia* Heydrich, in common with several other so-called segregate genera from *Lithophyllum* Philippi, is based on *Lithophyllum incrustans* Philippi, and is therefore a homotyic synonym [*sensu* Woelkerling, 1983] of Philippi's *Lithophyllum*. The question of whether the genus *Pseudolithophyllum* Lemoine can in turn be supported as a good segregate from *Lithyophyllum* depends on interpretation of the early stages of vegetative growth at the anatomical level, and is currently under consideration by various workers. We thank Linda M. Irvine for these comments and for resultant discussions. Since definitive presentation according to nomenclatural and taxonomic process is not yet possible (see Woelkerling, 1983; Mendoza & Cabioch, 1985; Chamberlain & L. Irvine, in prep.), we have followed the rather arbitrary course of reallocation according to the application of reasoning in the papers mentioned above. This ignores possible differences in local interpretations and applications of names, both generic and specific, but (since cross-referencing in full is maintained) in no way misleads or causes confusion as to the destinations of particular published records.

Crodelia expansa (Philippi) Kylin
See *Pseudolithophyllum expansum* (Philippi) Lemoine.

Crodelia orbiculare (Foslie) Kylin
See *Lithophyllum orbiculatum* (Foslie) Foslie.

Crouania attenuata (C. Agardh) J. Agardh
Canaries (13; 33; 38B; 38D; 108; 227; 232B; 238; 375; 379).
Salvage Islands (38B; 38D; 231).
'Atlantique (de l'Angleterre au Maroc et aux Canaries . . .)' (33).
'Widespread in temperate to tropical seas.' (559).
[As *Crouania attenuata* (Bornet) J. Agardh]
Canaries (225).
[As *Crouania attenuata* (Bonnemaison) J. Agardh]
Canaries (16; 71; 97; 177; 184; 190; 191; 196; 253; 489; 556).
Salvage Islands (556).
Sénégal (529).
'Atlantic Ocean (European and African coasts, Canary Islands' (177).
'Atlántico (Inglaterra – Canarias . . .)' (253).
'*Atlantique*, de l'Angleterre aux Canaries' (190; 196).
'côtes occidentales d'Afrique et aux Canaries' (184).
'English coast southwards to the Canary Islands' (71).
'Pantropical' (529).
'warmer shores of the Atlantic Ocean' (61).
[As *Crouania attenuata* f. *bispora* (Crouan) Hauck]
'Atlantique de l'Angleterre aux Canaries' (196).
'European and African coasts, Canary Islands' (177).

Crouania sp.
Ascension (37).
Gabon (294).
Ghana (299; 376; 377).

Note. John & Lawson (294) described a form as simply 'Crouanieae', since absence of the reproductive structures precluded further determination. Askenasy (37) recorded small tetrasporangial fragments of an unknown species from 7–8 fathoms depth.

Crouriella armorica P. & H. Crouan
See *Peyssonnelia armorica* (P. & H. Crouan) Weber-van Bosse in Børgesen.

Cruoriopsis rosenvingii Børgesen
See *Peyssonnelia armorica* (P. & H. Crouan) Weber-van Bosse in Børgesen.

Cruoriopsis sp.
Angola (352).

Note. It is not yet clear whether or not this record relates to *Cruoriopsis rosenvingii* Børgesen, and therefore in turn should be entered at *Peyssonnelia armorica* (q.v.).

Cryptonemia
Gross determination of many species within this genus is sometimes affected by marginal inflation of the frond and colour darkening following expansion of medullary tissues, especially in young plants. Within the checklist area, this particularly affects *Cryptonemia crenulata* and, to a lesser extent, the '*C. luxurians*' form of *C. seminervis* (q.v.).

Cryptonemia ? ceylanica
Sénégal (59).

Note. This may well represent a *nomen nudum* since, apart from the brief comment by Bodard & Mollion (59: 199), we have been unable to locate further comment or, indeed, a description. It is this general situation to which the doubt expressed above relates. The statement in 59 reads: 'L'autre *Cryptonemia* ne peut être déterminé, il a été récolté une seule fois stérile, c'est une petite lame stipitée et ramifiée, cependant il présente certaines analogies avec *C. ceylanica*'. Apart from the status of the taxon and its limits, there also remains the problem of application of the name; what does the material actually represent? See also the entry for *Cryptonemia* sp., with regard to comments on perhaps similar material reported in Sourie (529).

Cryptonemia crenulata (J. Agardh) J. Agardh
Canaries (232B).
Ghana (155; 299; 300; 350; 376; 491).
'in warm temperate and tropical parts of the Atlantic Ocean' (350).
'tropical western Africa' (36B).

Note. See Lawson & John (350) for some comments on the taxon. It has been suggested by De Toni (134) that the subgenus *Acrodiscus* J. Agardh should be raised to generic rank, but this has not been universally followed; *Cryptonemia crenulata* would fall within this new genus, if adopted. See Guiry & Irvine (155) for comparison tables of species characteristics. Regarding the Norris & Aken (417A) suggestion that there should be recognised a single species of which *C. crenulata, C. seminervis* (q.v.), and *C. luxurians* (q.v.) are all manifestations, see the entry to *C. seminervis*. Lawson & John (350: 250, sub *C. luxurians*) also quoted Guiry's opinion on the strong likelihood of conspecificity between *C. luxurians* and *C. seminervis*, with which we concur; it is less easy to accept the postulate that *C. crenulata* is also a variant manifestation of the same genome.

Cryptonemia hibernica Guiry & L. Irvine prox.
Namibia (36B).

Note. The recent record by Wynne (36B) from the drift south of Swakopmund, Namibia, was established with reservation since fertile plants were not available. Wynne indicated clear distinctions from material of the same genus reported under different species names by Lawson & John (350) and by Seagrief (1984) from adjacent areas.

Cryptonemia lactuca *auct.* [usually sensu J. Agardh, or (C. Agardh) J. Agardh]
See *Cryptonemia lomation* (Bertoloni) J. Agardh.

Cryptonemia lomation (Bertoloni) J. Agardh
Canaries (77; 191; 227).

Note. Børgesen (77) had several specimens, some with cruciate tetrasporangia, forming the basis of his first recording of the species for the Canaries. Levring (375) recorded the species on one occasion (dredged; 40–50m depths) in Madeira. Although the lectotype species of *Cryptonemia* is *C. lactuca* sensu J. Agardh, this latter has as taxonomic synonym *C. lomation* (Bertoloni) J. Agardh, for which taxon *'lactuca'* therefore provided a superfluous epithet. Thus, both *Sphaerococcus lactuca* C. Agardh and *Cryptonemia lactuca* (C. Agardh) J. Agardh are nomenclatural synonyms of *Fucus lomation* Bertoloni, regardless of taxonomic opinion. The correct name for this species in the genus *Cryptonemia* is therefore as employed for this entry heading. We are much indebted to Mrs L. M. Irvine and Dr P. C. Silva for these comments.

Cryptonemia luxurians (C. Agardh) J. Agardh
See *Cryptonemia seminervis* (C. Agardh) J. Agardh.

Cryptonemia seminervis (C. Agardh) J. Agardh
Côte d'Ivoire (287).
Ghana (153; 288; 338; 537).
Liberia (287).
Mauritanie (56; 252; 349).
Sénégal (47; 50; 52; 56).
Senegambia (27; 296).
'West Africa' (344).
[As *Cryptonemia seminervis* J. Agardh]
Mauritanie (56).
Sénégal (55; 56; 59; 122; 399; 529; 531; 542).
'De Biarritz aux Canaries et au Sénégal' (89).
'De la côte Basque au Sénégal' (542).
[As *Cryptonemia luxurians* (C. Agardh) J. Agardh]
Angola (298; 352).
Cape Verde Islands (223).

Côte d'Ivoire (?288; 350).
Ghana (155; 288; 290; 299; 350; 376; 377).
Liberia (350).
Sénégal (24; 50; 59).
'tropical Western Africa' (36B).
'tropical West African coast' (417A).
'widespread in warm temperate and tropical parts of the Atlantic Ocean' (350).
[As *Cryptonemia luxurians* J. Agardh]
Canaries (415; 415A).
Cape Verde Islands (38; 415; 415A).
Sénégal (38; 283).
[As *Cryptonemia luxurians* (Mertens) J. Agardh]
Sénégal (408).
[As *Cryptonemia luxurians* C. Agardh]
Liberia (129).
[As *Phyllophora* sp.]
Sénégal (282).

Note. Norris & Aken (417A: 56) commented that 'It seems possible that *C. luxurians, C. dichotoma, C. crenulata, C. bengryi* and *C. seminervis* may be variants of a single species.' Other authors had previously published on possible conspecificity of various species pairs within this overall group; for reservations in some cases, however, see the entry to *Cryptonemia crenulata*. Acceptance of the highly probable conspecificity of *C. seminervis* and *C. luxurians* leads to the need to assess which epithet is the earlier. Both were published by C. Agardh in *Species algarum* . . . **1**(2) (entry 19 in the bibliography) and previous assumptions of the antedating by *luxurians* as epithet may derive from the situation there, since that epithet is described at varietal level (*Sphaerococcus lactuca* var. γ *luxurians*) in the entry which precedes (pp. 231–232) *Sphaerococcus seminervis* (p. 232), the basionym of *Cryptonemia seminervis*. However, these assumptions ignore the reference in the latter entry to the earlier publication in *Icones algarum ineditae* . . . of C. Agardh. Fascicle 2 of that work, although dated on the title-page as 1821, is generally considered (e.g. in Stafleu & Cowan, 1976) to have appeared in early 1822, whereas the earliest version of *Species algarum* . . . 1(2) was published later (probably October) in that same year. Hence, even if the inclusion of data referring to *Icones* . . . in the *Species algarum* . . . entry were on the basis of text then only in proof rather than published, the former still clearly antedates. *C. seminervis* is therefore the earliest, and hence the correct, name for the taxon when these names are considered to apply to the same species. We here so consider them.

The delimitation and recognition of *Cryptonemia seminervis* and *C. luxurians* as morphologically separate species have always been sources of doubt and fluctuating viewpoint, for the present list area no less than elsewhere. For Mauritanie, for example, the record in Lawson & John (349) is based directly on the previously published information in Bodard (56) and in Hariot (252). Of that basis, Bodard (56) commented for his data that 'on peut se demander si le *C. luxurians* exist vraiment', this for both Mauritanie and Sénégal. He had previously (50) expressed doubt on the homogeneity of his collections from Sénégal, in stating: 'Il est certain que *C. seminervis* existe, peut-être est-il en mélange avec *C. luxurians*.'

Under the name *C. luxurians* occurs the only unqualified record of the species from the Cape Verde Islands (223). Earlier reference to the existence there of *C. seminervis* was in terms of a future forecast, not extant data, by Askenasy (38): 'n'ont pas été rapportée . . . des îles du Cap Vert; il est très probable qu'elle . . . y croissant aussi et qu'on [la] . . . trouvera plus tard'.

Attribution here of the record published earlier (as *Phyllophora* sp.) for Sénégal by Jardin (282) is on the basis of his own later (283) comments that it was necessary to add to the early list for that country 'le *Cryptonemia luxurians*, J. Ag., que j'avais inscrite sous le nom de *Phyllophora* et qui vient d'être déterminée par le savant algologue G. Lespinasse, de Bordeaux.'

Cryptonemia sp.
Gambia (296; 350).
Ghana (92).
Sénégal (59; 529).

Note. It is probable that records from Gambia (material sterile; conspicuous mid-rib) and Ghana relate to one or other of the morphologies attributed to the species here listed as *Cryptonemia seminervis* (q.v.).

In view of the comments by Sourie (529) and/or Jean Feldmann, however, we have also drawn attention to the Sénégal data in 529 under *Cryptonemia ceylanica* (q.v.). The *Halymenia* sp. *a* (q.v.) in Bodard (50) is stated to have a strong resemblance to *Cryptonemia* sp. but to be nearer to *Halymenia* in carposporophyte and tetrasporangial structure.

Cryptopleura calophylloides (J. Agardh) Wynne
Namibia (36B).

Note. See Wynne (36B) for detailed comparative treatment involving adjacent taxa, including *Cryptopleura ramosa* (Hudson) Kylin ex Newton.

Cryptopleura ramosa (Hudson) Kylin ex Newton
Western Sahara (349).
[As *Cryptopleura ramosa* (Hudson) Kylin]
'Atlantique: des côtes anglaises jusqu'au Rio de Oro' (222)
'Atlantique (des Feroes au Rio de Oro . . .)' (33)
[As *Acrosorium reptans* (Crouan frat.) Kylin]
Canaries (13; 38D; 227).

Note. Certain records nominally attributable here would, because of confused application of names, more correctly appear under *Acrosorium uncinatum* (q.v.). The general situation is explained in the note to the latter entry. Levring (375) commented on the difficulties of separating *A. reptans* and *A. uncinatum*, when sterile. The record for Western Sahara in Lawson & John (349) is based solely and directly on Ardré (33) and Gayral (222). See also Wynne (36B).

?**Cryptopleura**
Ghana (350).

Note. A flattened foliaceous plant with a network of macroscopic veins and crenulate margins was found on a number of occasions at depths greater than 10m off Ghana; sometimes it was one of the most common algae. Attribution may correctly be as a species of *Halymenia* (John et al., 299, 300; Lieberman et al., 376) or of *Cryptopleura*. Both genera are of ill-defined limits and in need of critical revision (Abbott & Hollenberg, 1976).

Ctenosiphonia hypnoides (Welwitsch ex J. Agardh) Falkenberg
Canaries (38D; 71; 191; 281; 351; 517).
'Atlántico desde cabo Figuier a Canarias' (517).
'Atlantique (du fond du Golfe de Gascogne – Cap Figuier aux Canaries)' (33).
'English Channel southwards to the Canary Islands' (71).
[As *Ctenosiphonia hypnoides* (Webw. [sic!] ex Agardh) Falkenberg]
Canaries (227).

Note. The Canaries and Morocco appear jointly to represent the currently known southern limits of distribution.

Dasya acanthophora Montagne
See *Polysiphonia flexella* (C. Agardh) J. Agardh.

Dasya arbuscula *auct.*
See *Dasya hutchinsiae* Harvey in W. Hooker.

Dasya baillouviana (S. Gmelin) Montagne
Canaries (38B; 38C; 38D; 392).
Ghana (299; 350; 376; 377).
Salvage Islands (38B; 38D; 556A).
'probably widespread in warm temperate and tropical seas' (350).
[As *Dasya baillowiana* Martens]
Canaries (401).
[As *Dasya Baillowiana* Montagne]
Canaries (44; 403).
[As *Dasya elegans* C. A. Agardh]
Canaries (89; 259).
[As *Dasya elegans* (Martens) C. Agardh]

Canaries (26; 28; 133; 239; 318; 439).
[As *Dasya pedicellata* (C. Agardh) C. Agardh]
Canaries (18; 71; 191; 226; 227; 232B; 234; 239; 375).
Ghana (152; 234).
'Atlantique (de Cadix aux Canaries . . .)' (190).

Note. For the terminal sub-heading above, records established under the nomenclature as presented, those citing authorities as simply C. Agardh, and the occasional variant such as '(Agardh)', have all been grouped together as no confusion is likely. Børgesen (71) repeated Montagne's (401) and Piccone's (439) records from the Canaries. Many of the previous reports indicated material from the sublittoral and found on only a few occasions. Curiously, Audiffred (38C: 174) did not repeat the record for the Salvage Islands.

Dasya caraibica Børgesen
Canaries (18).

Note. A full description, including data on tetrasporangia and cystocarps (data not hitherto available), was published by Cribb (113: 102–103).

Dasya corymbifera J. Agardh
Canaries (38C; 38D; 71; 89; 190; 191; 227; 232B; 375; 556).
Salvage Islands (38B; 38C; 38D; 556; 556A).
'Atlantique (de l'Angleterre aux Canaries . . .)' (190).
'D'Angleterre aux Canaries' (89).
'English coast southwards to the Canary Islands' (71).
'From the British coast southwards to the Canaries' (375).
'In oceano calidiore atlantico' (28).

Note. Børgesen's (71) record is simply a repeat of that in Bornet (89). Weisscher (556: 64) seems to have had only a single specimen, determined by comparison with the figure given by Coppejans (1977, pl. 191). In Audiffred (38C: 174), the specific epithet is mis-rendered '*comrymbifera*'.

Dasya crouaniana J. Agardh
Canaries (18).

Note. Previously known only from the warmer waters of America; this represents the first record for the eastern Atlantic.

Dasya delilei Montagne
See *Asparagopsis taxiformis* (Delile) Trevisan.

Dasya elegans (Martens) C. Agardh [or simply C. Agardh]
See *Dasya baillouviana* (S. Gmelin) Montagne.

Dasya hutchinsiae Harvey in W. Hooker
Canaries (33; 38D; 128A; 226; 227; 229; 230; 375).
Salvage Islands (38D; 375).
Senegambia (296).
[As *Dasya arbuscula* Harvey in W. Hooker]
Canaries (225).
[As *Dasya arbuscula* (Dillwyn) C. Agardh]
Canaries (71; 190; 191; 236; 401; 439).
Salvage Islands (38B; 215; 231).
Senegambia (23; 26; 133).
'Atlantique nord (de l'Angleterre aux Canaries)' (190).
'English coast southwards to the Canary Islands' (71).
'in mari atlantico ab insulis Orkney usque ad littora Senegambiae' (23).
'in oceano atlantico a Scotia usque ad Senegambiam' (26).
'in oceano Atlantico a Scotia usque ad Senegambiam Africae' (133).
[As *Dasya arbuscula* C. Agardh]
Canaries (44; 89).
'De la Grande-Bretagne aux Canaries' (89).
'Atlantique (. . . Africa)' (410).

[As *Eupogonium Arbuscula* (C. Agardh) Kützing]
'ad oras . . . Africae (Senegambiae)' (318).

Dasya ocellata (Grateloup) Harvey in W. Hooker
Canaries (13; 18; 33; 38D; 71; 177; 190; 191; 226; 227; 232B; 306B; 375; 517).
Sénégal (55).
'Atlántico (de Inglaterra a Canarias)' (517).
'Atlantique (de l'Angleterre aux Canaries . . .)' (190).
'Atlantique (. . . Canaries . . .)' (33).
'Atlantischen Ozean . . . südwärts bis an die westafrikanische [Küste]' (499).
'Im Atlantischen Ozean von den südenglischen Küsten an bis zu den nordwestafrikanischen' (498; 499).
[As *Dasya ocellata* Harvey]
Canaries (547).

Note. In view of the isolated nature of the single Sénégal record, that report by Bodard (55) requires further confirmation.

Dasya pedicellata (C. Agardh) C. Agardh
See *Dasya baillouviana* (S. Gmelin) Montagne.

Dasya plana C. Agardh
See *Dasyopsis plana* (C. Agardh) Zanardini.

Dasya rigidula (Kützing) Ardissone
Canaries (232B).
Salvage Islands (38B; 38D; 556; 556A).
[As *Eupogonium rigidulum* Kützing]
Sénégal (283).

Note. Jardin (283: 255) commented that 'J. Agardh indique dans ses *Species inquirendae*, à la suite des *Dasya* . . . J'ai recueilli cette petite espèce dans la baie du Dakar, Sénégal'.

Dasya schmidtiana Sonder
Cape Verde Islands (38; 408; 500; 528).

Note. Montagne (408) did not see material but merely reported the Schmidt collection, as determined by Sonder (528). The latter had indicated close relationship to, but distinctions from, *Dasya velutina* Sonder (1845). Schmidt & Gerloff (500: 725) commented that: 'Die Zahl der Endemiten erscheint auf *Plocamium concinnum* Aresch. und *Dasya Schmidtiana* Sonder beschränkt'.

Dasya simpliciuscula C. Agardh
See *Wrangelia argus* (Montagne) Montagne.

Dasya solieri J. Agardh ex Montagne [or simply J. or C. Agardh]
See *Polysiphonia flexella* (C. Agardh) J. Agardh.

Dasya trichoclados J. Agardh
See *Lophocladia trichoclados* (C. Agardh) Schmitz.

Dasya velutina Sonder
See the note to *Dasya schmidtiana* Sonder.

Dasya wurdemannii Bailey ['*wurdemanni*'; authorities often as Bailey in Harvey]
See *Heterosiphonia crispella* (C. Agardh) Wynne.

Dasya sp. A.
Ghana (350; 376).

Note. On larger algae in the lower eulittoral and to 10m depth.

Dasya sp. B
Ghana (350).

Note. Collected on only one occasion from a rocky platform area at about 10m depth.

Dasya spp.
Ascension (37).
Bioko (350).
Canaries (253; 490).
Cape Verde Islands (100; 183).
Ghana (299; 491).
Sénégal (47; 55; 59; 529).

Note. Under the otherwise irrelevant entry for *Dasya Callithamnion* ? (Sonder) Harvey, Areschoug (37) indicated: 'Eine nicht näher bestimmbare Dasya hat die "Gazelle" von der Insel Ascension mitgebracht.'

Dasyopsis plana (C. Agardh) Zanardini
Canaries (71; 191; 226; 227).
[As *Dasya plana* C. Agardh]
Canaries (439).

Note. Børgesen (71) merely repeated the record from Piccone (439), although he saw a specimen of the Canaries material. This species is the lectotype species of *Dasyopsis*; another species, *Dasyopsis pinnatifolia* (Suhr) Schmitz is reported from Algoa Bay, South Africa. Such a generic distribution suggests that further finds from the warmer locations within the list area may be likely.

Delesseria hypoglossum Lamouroux
See *Hypoglossum hypoglossoides* (Stackhouse) Collins & Hervey.

Delesseria papenfussii Wynne
[As *Delesseria 'kylinii'* Papenfuss [*ined.*]]
Namibia (348; 522).

Note. The name *Delesseria 'kylinii'* was used in a list of species observed in Namibia kindly sent to the present authors by R. H. Simons; since Papenfuss had material from the collecting trip, it seems likely that his original aim, recognising an apparent new species, was to describe it. The delay in reporting the results of that trip, a matter still to be achieved, took the time-scale to beyond the time of the death of Papenfuss so that *D. 'kylinii'* remained a nomen nudum. It was at the time of our initial writing not clear from information available what was represented by the name and the entry was being maintained simply to avoid loss of data. After submission of our paper, the senior author discovered the recent (1984) paper by Wynne (573), in which the species represented by the name *D. 'kylinii'* was finally fully described under the name *Delesseria papenfussii*. Quite independently (see below), we had already concluded that our material reported from Angola under the name *Delesseria* sp. (q.v., 352) was very possibly the same as that previously called *D. 'kylinii'* in the Namibia list; studies were in progress to establish this. It is therefore interesting that Wynne, in his paper (573), discussing the distribution of his *Delesseria papenfussii*, commented: 'It is possible that the '*Delesseria* sp.' recorded from two sites on the Angolan coast by Lawson et al. (1975) is also this species, but it was not possible to examine their material. They did list a few species in Angola that are also present in South Africa.' If these two independent conclusions prove correct, *D. papenfussii* has a rather wider distribution and, probably, greater temperature tolerance than previously thought, being present in Angola, Namibia, and South Africa. The record in Lawson & Isaac (348) is a repetition of that provided by Simons (522). See also the entry for *Delesseria* sp.

Delesseria ruscifolia (Turner) Lamouroux [authority sometimes encountered – J. Agardh]
See *Apoglossum ruscifolium* (Turner) J. Agardh.

Delesseria sp.
Angola (352; 573).

Note. This is perhaps close to or conspecific with *Delesseria papenfussii* Wynne, q.v. Conclusions reached independently by ourselves and by Wynne (573) would seem to indicate quite wide distribution.

Dermatolithon
On the basis of their own studies (and of recent work by W. H. Adey), Woelkerling, Chamberlain & Silva (558A) have recently transferred 16 taxa from *Dermatolithon* and/or *Lithophyllum* to *Titanoderma* (q.v.). It is probable that all species in *Dermatolithon* will require such transfer, a probability that has led us (on nomenclatural grounds and for rationalisation) to effect those transfers necessary to cover all records from the present area.

Dermatolithon confinis (P. & H. Crouan) Boudouresque, Perret-Boudouresque & Knoepffler-Péguy
See *Titanoderma confinis* (P. & H. Crouan) J. Price, D. John & G. W. Lawson, **comb. nov.**
Melobesia confinis P. & H. Crouan in *Bull. Soc. bot. Fr.* **7**: 370 (1860), nom. nud.
Basionym: *Melobesia confinis* P. & H. Crouan, *Fl. Finistère*: 150 (1867).

Dermatolithon corallinae (P. & H. Crouan) Foslie
See *Titanoderma corallinae* (P. & H. Crouan) Woelkerling, Y. Chamberlain & Silva.

Dermatolithon cystoseirae (Hauck) H. Huvé
See *Titanoderma cystoseirae* (Hauck) Woelkerling, Y. Chamberlain & Silva.

Dermatolithon geometricum Lemoine in Børgesen
See *Titanoderma geometricum* (Lemoine in Børgesen) J. Price, D. John & G. W. Lawson, **comb. nov.**
Basionym: *Lithophyllum (Dermatolithon?) geometricum* Lemoine in Børgesen in *K. dansk. Vidensk. Selsk., Biol. Meddr.* **8**(1): 47, pl. I fig. 4, text-fig. 17 (1929).

Dermatolithon hapalidioides (P. & H. Crouan) Foslie
See *Titanoderma hapalidioides* (P. & H. Crouan) J. Price, D. John & G. W. Lawson, **comb. nov.**
Melobesia hapalidioides P. & H. Crouan in *Bull. Soc. bot. Fr.* **7**: 370 (1860), nom. nud.
Basionym: *Melobesia hapalidioides* P. & H. Crouan, *Fl. Finistère*: 150 (1867).
See also *Titanoderma confinis* (P. & H. Crouan) J. Price, D. John & G. Lawson.

Dermatolithon nepalidioides (P. & H. Crouan) Foslie
See *Titanoderma hapalidioides* (P. & H. Crouan) J. Price, D. John & G. W. Lawson.

Dermatolithon papillosum (Zanardini) Foslie
See *Titanoderma papillosum* (Zanardini ex Hauck) J. Price, D. John & G. W. Lawson **comb. nov.**
Lithothamnion papillosum Zanardini, *Sagg. classif. nat. Ficee*: 43 (1843), nom. nud.
Basionym: *Lithothamnion papillosum* Zanardini ex Hauck, *Rabenh. Krypt.-Fl.* 2nd ed., **2**: 272 (1885).
See also *Titanoderma cystoseirae* (Hauck) Woelkerling, Y. Chamberlain & Silva.

Dermatolithon polycephalum (Foslie) Foslie [*et auct.*]
See *Titanoderma polycephalum* (Foslie) Woelkerling, Y. Chamberlain & Silva.

Dermatolithon polyclonum Foslie
See *Titanoderma polyclonum* (Foslie) Woelkerling, Y. Chamberlain & Silva.

Dermatolithon pustulatum (Lamouroux) Foslie
See *Titanoderma pustulatum* (Lamouroux) Nägeli.

Dermatolithon sp.
See *Titanoderma* sp.

Dermonema amoenum Pilger
See *Nemalion amoenum* (Pilger) Børgesen.

Dictyurus fenestratus Dickinson
Ghana (35; 151; 290; 299; 300; 338; 350; 376; 377; 491; 567).
Sénégal (35).
'endemic to West Africa' (290).
'in warm temperate and tropical parts of the eastern Atlantic Ocean' (350).
[As *Dictyurus occidentalis* J. Agardh]
Sénégal (59; 122; 186; 191; 399; 542).
[As *Dictyurus* sp.]
Ghana (487).

Note. Dictyurus fenestratus apparently does not tolerate much emersion; all known reports involve plants either completely submerged or shaded/submerged for much of the time (Dickinson, 1951). Lawson & John (350) summarized matters in indicating Ghanaian specimens as occasional solitary individuals to about 22m depths; they, as Dickinson (151), did not detect reproductive structures. The Aregood & Hackett records (35) are based directly on Dickinson; data in Round (487) are derived from information provided by Lawson & John (various publications).

Dictyurus is generally recognised as being constituted by three species: *Dictyurus purpurascens* Bory (the type-species, from the Indian Ocean), *D. occidentalis* J. Agardh (from Mexico and the Caribbean), and *D. fenestratus* Dickinson. The French tradition of naming *Dictyurus* from Sénégal as *D. occidentalis* J. Agardh dates from the first incidental report by Feldmann (186) on the basis of material collected by Trochain, who repeated the data in his 1940 publication (542). All the other published records (also French) follow that custom, although Dickinson (151) clearly indicated the probable realities of the situation. Dickinson only hesitated about the distinctness of what she believed to be a new species of *Dictyurus* in V. J. Foote's collection because of the Feldmann naming-tradition and because of restricted material for comparison. She submitted Ghanaian material to Børgesen (see his comments in 151), who was very familiar with the 'real' *D. occidentalis*. Børgesen confirmed that nothing like the Ghanaian plant occurred in the area of *occidentalis*, but observed that he had a Sénégal specimen, sent by Feldmann, which agreed very well with the Ghanaian material. The fragment then sent by Børgesen proved to be the same as her Ghanaian plants and hence very different from the 'real' Mexican *occidentalis*; the differences are specified in Dickinson (151: 295).

Thus, we have transferred all Sénégal records to the present entry, this now representing the only species of *Dictyurus* so far detected in the list area.

Dictyurus occidentalis J. Agardh
See *Dictyurus fenestratus* Dickinson.

Dicurella flabellata (J. Agardh) J. Agardh
See *Trematocarpus flabellatus* (J. Agardh) De Toni.

Dicurella scutellata (Hering) Papenfuss
See *Trematocarpus flabellatus* (J. Agardh) De Toni (especially) and *Trematocarpus affinis* (J. Agardh) De Toni.

Dicurella sp.
See *Trematocarpus* sp.

Digenea simplex (Wulfen) C. Agardh
Ascension (474).
Canary Islands (13; 226; 227; 302; 304).
Cape Verde Islands (100; 183; 184; 191; 408; 535).
Ghana (153; 154; 350; 535).
São Tomé (184; 251; 265; 350; 535).
'apparently widespread in warm temperate and tropical seas' (350).
'Atlantique tropical et subtropical' (184).
'in den wärmeren Teilen des atlantischen und indischen Oceans.' (501).
'most warm seas' (78).
'Seems to occur in nearly all warm seas.' (62).
'world-wide . . . on tropical to warm temperate coasts' (267A).
[As *Digenea simplex* Agardh]
São Tomé (263; 264).
'Warm Atlantic' (410).
[As *Digenea simplex* J. Agardh]
Cape Verde Islands (38).
'seems to be rather uncommon in the Gulf of Guinea, and certainly of sporadic occurrence' (535).

Note. The generic name is very often erroneously spelt '*Digenia*'; records so established have been treated as though correctly spelt. Other taxa in this genus (e.g. *Digenea subarticulata* Simons), or in closely related genera (e.g. *Digeneopsis*), have been described (as new) from South Africa (Simons, 521: 10 and 11). Their distribution patterns may extend into the present list area.

Diplothamnion tetrastichum Joly & Yamaguishi
Ascension (475).

Note. Probably under-recorded rather than of odd distribution pattern. Likely to be found in detailed local surveys elsewhere in the list area, especially on offshore islands.

Dipterosiphonia dendritica (C. Agardh) Falkenberg
Canaries (3; 38B; 38D; 71; 191; 225; 375; 417A; 490; 555).
Salvage Islands (38B; 38D; 555).
[As *Dipterosiphonia dendritica* (C. Agardh) Schmitz]
Canaries (13; 16; 226; 227; 229; 304; 489; 517).
[As *Dipterosiphonia dendritica* (C. Agardh) Schmitz in Engler & Prantl]
Canaries (108).
[As *Polysiphonia dendritica* Hooker f. & Harvey]
Canaries (439).

Note. Piccone (439) recorded *Polysiphonia dendritica* Hooker f. & Harvey from the Canaries, based on Liebetruth's collection. Most probably this did refer to a legitimate record of *D. dendritica*, but it is unfortunate that Piccone's citation of authorities for *Polysiphonia dendritica* was in a form amongst those that De Toni (133: 1046–1047) felt were not referring to the species of *Dipterosiphonia* but rather 'forsan Metamorphes speciem repraesentat.'

Dipterosiphonia rigens (Schousboe ex C. Agardh) Falkenberg
Canaries (13; 38D; 71; 108; 133; 140; 179; 190; 191; 226; 227; 306B; 490).
'Atlantique de Cadix aux Canaries' (190).
'atlantische Küste von . . . Afrika' (179).
[As *Dipterosiphonia rigens* (Schousboe) Falkenberg]
Canaries (304).
[As *Polysiphonia rigens* C. Agardh]
'Ad oras . . . atlanticas tropicas' (318).
[As *Polysiphonia rigens* J. Agardh]
Canaries (439).

Note. The large majority of these records, excluding those in Børgesen and those of the recent Canaries group of workers in La Laguna, are secondarily based on Piccone (439) and Falkenberg (179). Cordeiro-Marino (108) emphasised the similarity of young stages of *Dipterosiphonia rigens* and *D. dendritica* (q.v.), although mature plants differ markedly in habit.

Dohrniella antillarum (W. Taylor) Feldmann-Mazoyer
Ghana (292; 299; 350; 376).
'in warm temperate and tropical parts of the Atlantic Ocean' (350).

Note. Unknown from the eastern Atlantic prior to John & Lawson's (292) report. Detected only sublittorally in 10–15m depths, which may be the main reason for previous failure to record the species.

Dudresnaya [aff.] **crassa** Howe
Sénégal (55; 59; 350).

Note. This alga seems to be wholly sublittoral in deepish waters, which may account for the rarity of detection. For some comments on the status of the species (or at least of the Lawson & John record in 350), see the notes under *Dudresnaya* sp. Bodard & Mollion (59: 199) stated: 'un *Dudresnaya* qui s'apparente au *D. crassa*', although elsewhere (in their 'Dragages' summary Table III), they referred only to '*Dudresnaya* sp.' (q.v.). *D. crassa* Howe was originally described from Bermuda; for a useful key to the genus, including *D. crassa* Howe, see Robins & Kraft (484A).

Dudresnaya verticillata (Withering) Le Jolis
Canaries (8; 38B; 38D; 227; 232B; 273; 484A).
Salvage Islands (38B; 38D; 556A).

Note. Also recorded from Madeira (375) and south to Tangier on the 'mainland' (188; 375). For a recent detailed treatment of *Dudresnaya*, including *D. verticillata* (Withering) Le Jolis, see Robins & Kraft (484A); the paper presents a useful key and table of comparative features.

Dudresnaya sp.
Ghana (299; 350; 376).

Sénégal (59).

Note. Lawson & John (350: 224) commented that: 'There has been collected off Ghana a lubricous alga having zonate tetrasporangia but no other reproductive organs have been found.' They suggested this as a probable member of the Dumontiaceae, adding that *Dudresnaya* is such a member, and that Bodard (55) reported *D.* aff. *crassa* (q.v.) off Sénégal whilst Lieberman et al. (376) recorded *Dudresnaya* sp. off Ghana. These, and the other record from John et al. (299), all appear above. Since there is some equivocation about the manner of citation of the Bodard & Mollion (59) record (see *D.* aff. *crassa*) it is also included here, although both references in the single text almost certainly refer to only one taxon. See Robins & Kraft (484A) for a recent comparative treatment of this genus; as a member of those Cryptonemiales and Gigartinales with soft mucilaginous thalli and simple morphology, it is also discussed comparatively in Hawkes (1982).

Dumontia canariensis Montagne
Canaries (25; 70; 132; 227; 318; 401; 407).
[As *Domontia canariensis* Montagne (sic!)]
Canaries (44).

Note. Børgesen (70) examined Montagne material called *Dumontia canariensis* but was unable to find the tetrasporangia shown in a supposed drawing of the same. He was also unable from the anatomy to come to a definite conclusion on determination. A detailed morphological and developmental analysis of the genus *Dumontia* (principally based on *D. contorta* (S. Gmelin) Ruprecht) was presented by Wilce & Davis (1984). J. Agardh (25: 360) placed *D. canariensis* within his *'Species inquirendae'* under the genus *Halosaccion*, but without effecting any formal new combination.

Epilithon corticiforme Lemoine
See *Melobesia membranacea* (Esper) Lamouroux.

Epilithon membranaceum (Esper) Heydrich
See *Melobesia membranacea* (Esper) Lamouroux.

Epineuron (?) **multifidum** (Lamouroux) Kützing
See *Amansia multifida* Lamouroux.

Epymenia capensis (J. Agardh) Papenfuss
[As *Rhodymenia capensis* J. Agardh]
Namibia (168; 500).
[As *Epymenia stenoloba* Schmitz]
Namibia (128).

Note. See Seagrief (1984: 26) for synonymy followed here. The record in Schmitz & Gerloff (500) is entirely secondary. See also the notes to *Rhodymenia linearis* J. Agardh.

Epymenia obtusa (Greville) Kützing
Namibia (36B; 128; 348; 453; 522; 523).

Note. Records from Namibia reveal an apparent restriction in local distribution to growth in the sublittoral or in deep pools. The taxon may well, therefore, be more widespread.

Epymenia stenoloba Schmitz ex Mazza
See *Epymenia capensis* (J. Agardh) Papenfuss.

Erythrocystis montagnei (Derbès & Solier) Silva
Canaries (13; 38B; 38D; 128A; 226; 227; 253; 306B; 379).
Salvage Islands (38B; 38D; 253).
'Atlántico Oriental (Salvajes, Canarias y costa oeste africana)' (253).
[As *Ricardia montagnei* Derbès & Solier in Derbès]
Canaries (71; 139; 190; 191; 216; 375; 489; 490; 555; 556).
Salvage Islands (71; 215; 216; 231; 375; 555; 556; 556A).
São Tomé (93; 350; 535).
'in warm temperate and tropical parts of the eastern Atlantic Ocean' (350).

Note. Seems mostly to occur on *Laurencia obtusa*, less often on *Chondria tenuissima*.

Erythroglossum sandrianum (Zanardini) Kylin
See *Erythroglossum schousboei* J. Agardh

Erythroglossum schousboei J. Agardh
Western Sahara (349).

Note. The only immediately peripheral record of importance to the list area and involving *Erythroglossum* is that given by Levring (375), in reporting *E. sandrianum* (Zanardini) Kylin (on the basis of a few sublittoral specimens) for Madeira. Morocco was also mentioned in the quoted distribution. Perhaps the above record represents the same taxon, whatever its correct name. It seems possible that occasional specimens may occur sublittorally on the Canaries and Salvage Islands.

Eucheuma denticulatum (Burman f.) Collins & Hervey
See *Fucus spinosus* L.

Eucheuma schrammii (P. & H. Crouan ex Schramm & Mazé) J. Agardh
See *Meristotheca schrammii* (P. & H. Crouan ex Schramm & Mazé) J. Price, D. John & G. W. Lawson, **comb. nov.**
Basionym: *Mychodea Schrammii* P. & H. Crouan ex Schramm & Mazé, *Essai alg. Guadeloupe*: 10 (1865).

Eucheuma spinosum (L.) J. Agardh
See *Fucus spinosus* L.

Euhymenia (Meristotheca) papulosa
See *Flahaultia appendiculata* Bornet.

Euhymenia schizophylla Kützing
Namibia (348; 453).

Note. The record in Lawson & Isaac (348) is purely secondary. The genus *Euhymenia* Kützing is no longer accepted. De Toni (131: 296, 300) suggested for *E. schizophylla* Kützing that it is *not Callymenia schizophylla* (Harvey) J. Agardh but (p. 296) 'forsan ad *Callymeniam dentatum* pertinet' and (p. 300) placed it with '?' in the synonymy of his entry for *Callymenia dentata* J. Agardh. *C. dentata* J. Agardh was only provisionally included by Seagrief (1984: 9), (although described from material from Caput Bonae Spei) on the basis of a report in Delf & Michell (128: 106) of its presence in various localities along the South African coast. This attribution is therefore not impossible for collections from Namibia. The attribution in turn of this name *Callymenia dentata* J. Agardh is usually currently to *Anatheca montagnei* Schmitz (q.v.), but whether correctly so in this case is not clear. *Anatheca montagnei* has not, so far as we can trace, been otherwise reported between Ghana and South Africa. Hence, the original name, however inaccurate, is retained pending further clarification.

Eupogonium arbuscula (C. Agardh) Kützing
See *Dasya hutchinsiae* Harvey in W. Hooker.

Eupogonium rigidulum Kützing
See *Dasya rigidula* (Kützing) Ardissone.

Falkenbergia hillebrandii (Bornet) Falkenberg
See *Asparagopsis taxiformis* (Delile) Trevisan.

Falkenbergia rufolanosa (Harvey) Schmitz
See *Asparagopsis armata* Harvey.

Falkenbergia sp.
See *Asparagopsis* sp.

Fauchea hassleri Howe & W. Taylor
Sénégal (56; 59).
[As *Fauchea senegalensis* Bodard]
Sénégal (?55; 182).

Note. The precise significance of the application of these names within the list area remains unclear. G. Feldmann & Bodard (182) mentioned the name *F. senegalensis* Bodard as 'nov. sp.' but gave no further information. Later, Bodard's own (55: 16) tabular entry recorded clearly the same information in a rather more expanded form in stating presence at depths of 7–20m. The material concerned was then referred to as '*Fauchea senegalensis* (nomen) = *F. hassleri* Howe et Taylor (?).' In order to record the matter at all here, we have adopted this doubtful equivalence, purely as a convenience. The subsequent publication in

Bodard (56) and Bodard & Mollion (59) made no mention of the name *F. senegalensis*, but simply recorded the matter under *Fauchea hassleri* Howe & W. Taylor, originally applied to material from Cabo Frio (Brazil). Bodard & Mollion (59) then stated: 'c'est une des seules correspondances typiques que nous ayons trouvée entre les deux faces de l'Atlantique.' See also *Fauchea repens* (C. Agardh) Montagne & Bory ex Montagne.

Fauchea repens (C. Agardh) Montagne & Bory ex Montagne
'in wärmeren Teile des atlantischen Oceans' (517).

Note. It is not certain, although probable, that the background information on which is based the Schmitz & Hauptfleisch (507) statement of *Fauchea repens* distribution represents derivation from data on the taxon elsewhere reported as *F. hassleri* Howe & W. Taylor/*F. senegalensis* Bodard.

Fauchea senegalensis Bodard
See *Fauchea hassleri* Howe & W. Taylor.

Feldmannophycus rayssiae (J. & G. Feldmann) Augier & Boudouresque
Salvage Islands (38B; 556A).

Flahaultia appendiculata Bornet
Angola (352).

Note. Bornet's (89: 118–120 [= 278–280]) original description of this alga was based on information in an unpublished MS by P. K. A. Schousboe; the latter, collecting material from Dar Hamra (Tangier), had called the plant *Platoma appendiculata*. Bornet added that the structure of the alga is like that figured by Kützing (325: tab. 73) as *Euhymenia (Meristotheca) papulosa*, also from Dar Hamra. It remains to be established whether or not two different taxa are really involved in the records under this present name and under that of *Flahaultia palmata* Barton (q.v.).

Flahaultia palmata Barton
Angola (41; 42; 139).

Note. Barton (41: 372), in presenting her diagnosis of this new species, stated the differences between *Flahaultia palmata* and *F. appendiculata* to rest mainly with the distribution of reproductive tissues (cystocarps marginal; sporangia scattered sparsely throughout the frond, in *F. palmata*). There remains doubt as to whether these two are really separate species; locational and ecological differences (*palmata* – lower intertidal/shallow sublittoral; *appendiculata* – from (2–)5–10m depths), apart from other apparent differences deriving from essentially small samples, could strongly affect conclusions drawn. It seems likely that the present records should be added to those attributed to *F. appendiculata* (q.v.).

Fosliella farinosa (Lamouroux) M. Howe
Canaries (12; 13; 38B; 38D; 94; 98; 188; 191; 226; 227; 253; 292; 392).
Cape Verde Islands (292).
Gabon (294; 350).
Gambia (296; 350).
Ghana (292; 350; 376; 377; 491).
Mauritanie (38B; 38D; 292; 349).
St Helena (541).
Salvage Islands (38B; 38D).
'Africa, Canaries' (98).
'Cosmopolite dans toutes les mers chaudes et tempérées' (188).
[As *Fosliella farinosa* (Lamouroux) M. Howe f. *callithamnioides* (Foslie) Y. Chamberlain]
Canaries (94).
[As *Fosliella farinosa* (Lamouroux) M. Howe f. *farinosa*]
Canaries (94).
[As *Fosliella farinosa* var. *solmsiana* (Falkenberg) W. R. Taylor]
Ghana (350).
[As *Fosliella farinosa* var. *solmsiana* (Falkenberg) J. Feldmann]
Canaries (12; 188).
[As *Melobesia farinosa* Lamouroux]
Canaries (6; 16; 225; 229; 230; 356; 359; 439; 493; 517; 556).
Cape Verde Islands (252; 366; 450; 451).

Mauritanie (252; 356; 359; 556).
St Helena (142; 260; 391).
Salvage Islands (215; 439; 556; 556A).
Sénégal (356).
'Almost cosmopolitan' (375).
'Atlantic Ocean (European and African coasts, Canary Island . . .)' (177).
'Common almost everywhere except in the arctic and antarctic regions' (200).
'Cosmopolitan' (366).
[As *Melobesia farinosa* Lamouroux var. *Solmsiana* (Falkenberg) Lemoine (= *callithamnioides* Falkenberg)]
Canaries (235; 357; 362; 363; 493).
[As *Melobesia Solmsii* Bornet in herb. (= *callithamnioides* Falkenberg, Solms)]
Canaries (356).
[As *Melobesia farinosa* Lamouroux f. *typica*]
Canaries (493).
[As *Melobesia farinosa* Lamouroux f. *callithamnioides* (Falkenberg) Foslie]
Canaries (202; 493).
[As *Melobesia farinacea* Lamouroux]
Cape Verde Islands (38).
'Cosmopolite' (38).

Note. The various confusions as to nomenclatural status of the variety *solmsiana* are detailed and discussed by Taylor (1939). No authorities are cited for the varietal name as used in Afonso-Carrillo & Gil-Rodriguez (12). The reported host seems mostly to be *Sargassum* or *Cymodocea*. Lemoine (366) commented of *Fosliella farinosa* (amongst other epiphytic crustose corallines) 'Ces espèces déterminées par d'anciens auteurs (Piccone, Askenasy, Dickie) sont à reviser.' So far as *Fosliella* is concerned, that required revision has been largely completed by Chamberlain (94; q.v. for general background).

Fosliella lejolisii (Rosanoff) Howe
See *Pneophyllum lejolisii* (Rosanoff) Y. Chamberlain.

Fosliella minutula (Foslie) Ganesan
See *Pneophyllum confervicolum* (Kützing) Y. Chamberlain.

Fosliella spp.
Angola (352).

Fucus acicularis Turner
See *Gigartina acicularis* (Roth) Lamouroux.

Fucus aeruginosus Turner

Note. See *Gracilaria multipartita* (Clemente) Harvey and *Gracilaria corticata* J. Agardh, for details of attribution of the Hornemann (271) records for Ghana.

Fucus cartilagineus L.

Note. See *Gelidium versicolor* (S. Gmelin) Lamouroux and *Gelidium cartilagineum* (L.) Gaillon for details of the record by Bory (90) from the Canaries.

Fucus crispus L.

Note. See *Chondrus crispus* Stackhouse for consideration of the Hornemann (271) records from Ghana.

Fucus griffithsiae Turner

Note. See *Gymnogongrus griffithsiae* (Turner) Martius for comments on the Hornemann (271) records from Ghana.

Fucus lycopodioides *Flora Danica*
Canaries (90).

Note. Since this is essentially a cross-referencing entry, despite the detail, the original mode of citation has been maintained in the heading. Purely on nomenclatural grounds, the Bory de St-Vincent record in 90 would probably be attributable to *Rhodomela lycopodioides* (L.) C. Agardh. This, however, is extremely unlikely to be the accurate assessment on biogeographical evidence and the record probably represents an occurrence of *Halopitys incurvus* (Hudson) Batters (q.v.).

Fucus perforatus Bory

Note. See *Carpococcus perforatus* (Bory) J. Agardh, *Gigartina acicularis* (Roth) Lamouroux, and *Laurencia perforata* Montagne.

Fucus pinnatifidus L.

Note. See *Laurencia brongniartii* J. Agardh and *Laurencia pinnatifida* (Hudson) Lamouroux for details of possible attribution of the Hornemann (271) records from Ghana.

Fucus plumosus L.

Canaries (90).

Note. Little additional information is given in connection with the record of this 'species' by Bory (90). Neither locational nor habitat data are provided, and the plant is not illustrated. Hence, without herbarium studies to identify specimens concerned (if retained), there is no means of establishing with certainty the species being referred to. Purely speculatively, the use of this name may well have been in regard to a species of *Heterosiphonia*. *H. crispella* (C. Agardh) Wynne [= *H. wurdemannii* (Bailey ex Harvey) Falkenberg], for example, has frequently been recorded for the Canaries and, more recently, the Salvage Islands.

Fucus rubens L.

[As *Fucus rubens* Reich. in Spec. plant.]

Canaries (90).

Note. There is a similar lack of hard information for the report of this name as for that of *Fucus plumosus* L. (see above) in the publication by Bory (90). *Fucus rubens* L. is the basionym of *Phycodrys rubens* (L.) Batters, so that provided there was some degree of consistency in name-application, the above record *may* represent the occurrence of a Delesseriaceous taxon such as *Erythroglossum*, at its range periphery. Note the comments at the entry for *Erythroglossum schousboei* J. Agardh.

Fucus soboliferus *Flora Danica*

Note. Essentially a cross-referencing entry. The name is usually taken to be the basionym of the variety *soboliferus* of *Palmaria palmata* (L.) O. Kuntze, although such varieties are now allocated little or no real taxonomic significance. See the comments under *Palmaria palmata* for data on the record from Ghana in Hornemann (271).

Fucus spinosus L.

Canaries (90).

[As *Eucheuma spinosum* (L.) J. Agardh]

'forsan usque ad Cap. B. Spei descendens.' (131).

Note. Bory de St-Vincent (90: 304) recorded *Fucus spinosus* from 'Dans les trous des rochers de la rade de Sante-Croix.' De Toni (131: 369–370) established, in agreement with J. Agardh, *F. spinosus* L. as the basionym of *Eucheuma spinosum* (L.) J. Agardh. This is generically in accord with the views of Seagrief (1984: 29), who attributed *F. spinosus* to the synonymy of *Eucheuma denticulatum* (Burman f.) Collins & Hervey. *Eucheuma*, as a genus, has not been legitimately recorded from any part of the present list area; hence, the identity of the Bory specimens requires re-establishment. The framework of De Toni's (131) distribution statement is 'in oceano Indico', so that he probably had no intention of offering data for the western coasts of Africa. The De Toni statement is included here for completeness only.

Fucus uvarius L.

See *Botryocladia botryoides* (Wulfen) J. Feldmann.

Fucus versicolor S. Gmelin

Note. See *Gelidium versicolor* (S. Gmelin) Lamouroux and *Gelidium cartilagineum* (L.) Gaillon for comments on the early record in Bory (90) for the Canaries.

Fucus vittatus L.

Note. See *Suhria vittata* (L.) J. Agardh for attribution of the Hornemann (271) records from Ghana.

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—— 1820–46. *Icones algarum ineditae*. Fasc. 1. Lundae, 1820; Fasc. 2. Holmiae, 1822 [1821 on title-page]; Fasc. 3. Lundae, 1846.

—— 1822. *Species algarum rite cognitae* . . . **1** (2). Lund.

Note. There is another version of this first volume beside that issued at Lund. The parts issued at Griefswald were dated 1821 [part 1] and 1823 [part 2] and had title-pages different to those of the Lund issues.

20. —— 1824. *Systema algarum*. Lund.

Note. Facsimile reprint, A. Asher & Co., 1965.

21. —— 1828. *Species algarum rite cognitae* . . . **2**(1). Gryphiae.

22. —— 1828–1835. *Icones algarum europaearum. Représentation d'algues européennes . . .* Leipzig.
Note. This work was obviously published originally as a series of separate parts but we have made no attempt to investigate the dates when each of these appeared in print.

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24. —— 1851. *Species genera et ordines algarum, . . . floridearum, . . .* **2**(1). Lund.
Note. Facsimile reprint, J. Cramer, 1977.

25. —— 1852. *Species genera et ordines algarum, . . . floridearum, . . .* **2**(2). Lundae.
Notes. 1. The Corallineae (Ordo XII. pp. 506–576) was by J. E. Areschoug – so stated in volume. 2. Some versions of this second volume, Pars II, were issued as two separate texts – Pars II:1 being dated 1851 and Pars II:2, 1852. 3. There are also internal differences of numbering of pages between copies. BMNH copy is numbered straight through from 337–720, including therein the Addenda [701–706] and Index [707–720]. In the copy from which the Cramer (1977) reprint was prepared, the Index [unnumbered, of 14 sides] is placed immediately after p. 700 and is followed by six sides [also unnumbered] of Addenda. Content of these unnumbered sides is exactly as the numbered BMNH pages. The BMNH copy of Vol. 2 Part 3 (1863) commences with pages headed 'Ordo XIV. Wrangelieae', and numbered 701–715; these are followed by 'Ordo XV. Chondrieae' [pp. 716–786]. All these latter pages [701–786], also so numbered, are in the Cramer (1977) version placed immediately after the unnumbered Addenda pages (see above) and before the title page to Vol. 2, Part 3, of 1863, thereby implying that the copy facsimiled was also so arranged. Pages from 787 to 1291 are in both cases in Vol. 2, Part 3, 1863. Despite this, the Index in the end of the Cramer (1977) facsimile of Vol. 2, Part 3 (pp. 1279–1291] indicates the same page numbers as does the BMNH version. Both dated texts are indicated as the sources of data where the records occur in pp. 701–786 [textual pages]. The implication behind all this is that there may be yet other differently paged versions elsewhere.

26. —— 1863. *Species genera et ordines algarum, . . . floridearum, . . .* **2**(3). Lundae.

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Note. Extract by latter author of data from former author's publications; mentions by name 6 new endemic species out of the 7 so described for the Canaries.

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Note. See note accompanying entry 127.

127. —— 1842*b*. Essai sur une classification des algues et des polypiers calcifères [pp. 1–84]. [and] Mémoire sur les Corallines [pp. 85–116]. *In* Anon., *Académie de Paris. Faculté des Sciences. . . . Thèses présentées et soutenues à la Faculté des Sciences de Paris Le 19 Décembre 1842.*

Note. Repaged from papers by Decaisne in *Annls Sci. nat.* (Bot.) II, **17**: 297–380, 1842 and *Annls Sci. nat.* (Bot.) II, **18**: 96–128, 1842 [entry 126].

Note. Plates associated with the first of these thèses, like those in the original paper, bear erroneously the volume number *16*, despite being published in volume *17*.

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132. —— 1900. *Sylloge algarum omnium hucusque cognitarum* . . . **4**. *Sylloge Floridearum* . . . Sectio II – Familiae I–IV. Patavii.

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134. —— 1905. *Sylloge algarum omnium hucusque cognitarum* . . . **4**. *Sylloge Floridearum* . . . Sectio IV – Familiae I–VII. Patavii.

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136. —— 1909*a*. Litteratura phycologica florae et miscellanea phycologica. *Nuova Notarisia* **20**: 42–64.

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153. —— **& Foote, V. J.** 1950. Marine algae from the Gold Coast I. *Kew Bull.* **5**: 267–272.
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159A. See **Ballantine, D. L. & Wynne, M. J.** 1985.
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162. —— 1922*a*. Index, der aus Deutsch-Südwestafrika bis zum Jahre 1917 bekannt gewordenen Pflanzenarten. X. *Reprium Spec. nov. Regni veg.* **18**: 13–16.
163. —— 1922*b*. Index der aus Deutsch-Südwestafrika bis zum Jahre 1917 bekannt gewordenen Pflanzenarten. XI. *Reprium Spec. nov. Regni veg.* **18**: 248–256.
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Note. The page [2] of the last 3 explains that Ducluzeau, in haste to see his father, published this Dissertation without the intended 7 plates (legends given in text, pp. 86–89). He finished the drafts and tried to engrave them himself, directed by his friends, since he could not find in Montpellier a sufficiently accurate and delicate artist. He worked for a month or more to polish these plates on rough leather (all he could get), only to find too late that leather will not engrave well. It is stated by Ducluzeau that he would engrave these plates as soon as circumstances permitted; they were never published.

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Note. Data by J. H. Price in this publication have been given the number 178B.

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181. **Feldmann, G.** 1964. Sur une nouvelle espèce iridescente de *Chondria* (Rhodophyceae, Rhodomelaceae). *Revue gén. Bot.* **71**: 45–55.

182. —— **& Bodard, M.** 1965. Une nouvelle espèce de *Botryocladia* des côtes du Sénégal. *Bull. Inst. océanogr. Monaco* **65** (1342): 1–14.

183. **Feldmann, J.** 1935. Algues marines des Isles du Cap Vert recoltées par M. le Professeur Aug. Chevalier. *Rev. Bot. appl. Agric. trop.* **15**: 1069–1071.

Note. This is also published as a separate with the original page numbers retained at the top of each page and a new sequence (pp. 1–358) at the bottom of the page. See also no. 100.

184. —— 1937. *Recherches sur la végétation marine de la Méditerranée. La Côte des Albères*.

Note. Originally published as *Revue algol.* **10**: 1–339. Printed 28 October 1937, but published with '1938' on title-page of part. The separate form was published with '1937' on title-page and attributed inside as extracted from the *Revue Algol.* Tome X, Nov. 1937. The BMNH copy of the journal was received 22 June 1938. No textual differences exist between the two versions.

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Note. A reprint exists, repaged pp. [2]+1–27+[3].

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187. See **Gabrielson, P. W.** 1985.

188. **Feldmann, J.** 1939. Les algues marines de la Côte des Albères. IV – Rhodophycées. *Revue algol.* **11**: 247–330.

Note. Includes Bangiales, Nemalionales, Gelidiales and Cryptonemiales.

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Note. Covers the Gigartinales and Rhodymeniales.

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197. **Foslie, M.** 1897. On some Lithothamnia. *K. nor. Vidensk. Selsk. Skr.* **1897** (1): 1–20.

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—— 1900*a*. Remarks on Melobesiae in Herbarium Crouan. *K. nor. Vidensk. Selsk. Skr.* **1899** (7): 1–16, 1900.

198. —— 1900*b*. New or critical calcareous algae. *K. nor. Vidensk. Selsk. Skr.* **1899** (5): 1–34, 1900.

199. —— 1900*c*. Five new calcareous algae. *K. nor. Vidensk. Selsk. Skr.* **1900** (3): 1–6, 1900.

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Note. This represents one volume of an eight volume work. It is stated in the preface (p. vii) that the 'thalassiophytes' were determined by 'M. Agardh' (doubtless C. Agardh). Part 4, pp. 129–168, was published in June 1827. There are earlier geographically arranged chapters, pp. 3–146, that make occasional mention throughout of seaweeds for relevant areas. The Atlas is not relevant to the present work; there are no algal plates.

220. **Gauld, D. T. & Buchanan, J. B.** 1959. The principal features of the rock shore fauna in Ghana. *Oikos* **10**: 121–132.

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523. —— 1974. Algae, (including diatoms and seaweeds) [pp. 239–261]. *In* J. H. Day, N. A. H. Millard, & M.-L. Penrith, *A guide to marine life on South African shores.* 2nd ed. Cape Town & Rotterdam.

Note. The first edition (not seen) was probably 1969, since that is the copyright date and the Preface is dated April 1968. Overall tripartite editorship is obvious from both Copyright allocation and statements in Preface. Latter also clearly indicates responsibility of R. H. Simons for algal section. Presumably algal content of first edition was as in second, since preface statement unchanged from past. Relevant records are for Namibia.

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Note. The algal material was sent to Sonder in Hamburg; he worked on the plants and provided both the determinative data and text as printed.

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Note. From the note on p. 117, it is clear that the algae were worked on mainly by J. Feldmann, but that Sourie took account of some of the views of Dangeard as expressed in the latter's memoir on the Cap Vert (Dakar) peninsula algae. Since the exact contribution of the various people involved is in doubt, we have left the reference in the name of Sourie, who seems to have exercised overall authorship.

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Note. Sourie stated (p. 141) that many of the specific determinations of algae were by J. Feldmann.

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542. **Trochain, J.** 1940. Contribution a l'étude de la végétation du Sénégal. *Mém. Inst. fr. Afr. noire* **2**: [1–6]+1–433+[63].

Note. J. Feldmann clearly had a great deal to do with the main determinations on which the algal list (pp. 108–110) was based; since the extent to which the data were accepted or amended by Trochain is not clear, and since there are other parts to the text which seem definitely to have been attributable to Trochain, we have accepted the latter as overall author. For individual comments on species, the more correct authorship citation would undoubtedly be 'Feldmann, J., in Trochain, J.,' etc.

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Note. The congress concerned here was held in Sevilla, May 1929; the present paper was presented as a note at the congress and was subsequently published separately in Madrid, 1930, with pagination from pp. 1–40. A statement exists to the effect that the paper appeared in Tome 1 associated with the congress, p. 407 onwards. We have not been able to check that. The section on *Canarias* (pp. 17–18) has only three named species, including a *Corallina* (others – 1 green and 1 brown alga).

546. **Varo, J., Ramirez, J. & Renteria, J.** 1979. Estudio de la vegetación bentonica del litoral granadino. *Acta bot. malacitana* **5**: 79–98.

547. **Vickers, A.** 1897? ['1896']. Contribution à la flore algologique des Canaries. *Annls Sci. nat.* (Bot.) VIII, **4**: 293–306.

Note. The date is somewhat difficult to cite as there is some confusion regarding the dates of various issues. It does seem possible that pre-prints were issued in 1896; this is the date usually cited (see Lawson & Price, 1969: 345–346).

548. **Viera y Clavijo, J. de** 1866; 1869. *Diccionario de historia natural de las islas Canarias, . . .* **1** (A–G). Gran Canaria.

Note. The background to this work is explained in detail by Martin Aguardo (1957), who outlined (p. 8) the career of Viera y Clavijo and the progress of the work. The MS was completed in 1799, with the title *Diccionario de Historia Natural de las Canarias,* but was not published until the indicated dates. See also references 549 and 386. A further version of the work appeared in 1942 under the 'Publicaciones de la Biblioteca Canaria' series (Tenerife). A more recent (1982) new edition was edited by M. Alvar and included an introduction and appendix, with purely historical/literary data.

549. —— 1869. *Diccionario de historia natural de las Islas Canarias, . . .* **2** (H–Z). Gran Canaria.

Note. For full title and background note, see entry 548.

550. —— 1882. Catálogo de los géneros y especies de plantes singulares de les Islas Canarias. *Revista de Canarias,* nos. **77, 78, 79,** and **80**.

Note. These items were apparently published as an *Appendix* to the work in entries 548 and 549. Although completed in 1808, this Catálogo was not published until 1882. It is here quoted unseen, since we have been unable to locate copies, even in the Canary Islands (Universidad of La Laguna, Tenerife, recently noted as a centre of marine algal work in the region). Additional information or statements of content from known copies will be gratefully received. In view of the data in the original *Diccionario de Historia Natural* . . . (548, 549), it seems highly likely that this appendix has some relevance here.

551. **Webb, P. B.** 1849. Spicilegia Gorgonea; or a catalogue of all the plants as yet discovered in the Cape de Verd Islands . . . *In* W. J. Hooker, *Niger Flora* . . .: 89–197. London, Paris & Madrid.

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553. —— 1921. Liste des algues du Siboga II Rhodophyceae Première partie Protoflorideae, Nemalionales, Cryptonemiales. *In* M. Weber, *Siboga-Expeditie . . . Monographie LIXb. Uitkomsten op Zoologisch, Botanisch, Oceanographisch en Geologisch Gebied. . . . Livr. LXXXIX*: [6]+187–392+[4].

554. —— 1923. Liste des algues du Siboga III Rhodophyceae Seconde partie Ceramiales. *In* M. Weber, *Siboga-Expeditie . . . Monographie LIXc. Uitkomsten op Zoologisch, Botanisch, Oceanographisch en Geologisch Gebied. . . . Livr. XCIV*: [4]+311–392+[4].

555. **Weisscher, F. C. M.** 1982. Marine algae from Ilhéu de Fora (Salvage Islands). *Bolm Mus. munic. Funchal* **34**: 23–34.

556. —— 1983. Marine algae from Selvagem Pequena (Salvage Islands). *Bolm Mus. munic. Funchal* **35**: 41–80.

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Note. See reference 447 for explanation of dating.

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Note. For references carrying numbers 568–572 inclusive, see subsequent parts of the Florideae.

573. See **Wynne, M. J.** 1984.

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Cytology of the fern flora of Madeira

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Synopsis

A cytological survey of almost all the indigenous ferns of Madeira has been compiled from specially collected wild material. The chromosome numbers and/or pairing behaviour at meiosis are recorded photographically for 48 species or cytotypes, several of them new to science, and for two new or unfamiliar species-hybrids. New taxa include an amphidiploid *Hymenophyllum*, involving *H. tunbrigense* × *H. wilsonii*, together with the back-cross between this and *H. wilsonii*. There are two new hexaploid taxa, respectively in *Asplenium* and *Ceterach*, and the existence of a pentaploid hybrid *Polystichum*, involving *P. falcinellum* (octoploid) × *P. setiferum* (diploid), has been confirmed cytologically. Formal taxonomic descriptions of all these new taxa and hybrids will be given elsewhere under the authorship of M. Gibby and J. D. Lovis, though the cytology is recorded here. Finally, the evidence that the Macaronesian flora contains relictual fragments of the former (Tertiary) vegetation of Europe (the 'laurisilva') is briefly discussed in relation to the ferns of the ground-flora, and it is shown to have been greatly strengthened by recent finds of several characteristic Madeiran ferns still extant in southern Europe.

Introduction

The Island of Madeira, a Portuguese dependency, is located in a subtropical latitude in the north Atlantic Ocean, 850 km south of Lisbon and some 475 km west of the coast of Africa (Morocco). It is 57 km long and 22 km at the widest part, i.e. about the same area as the Isle of Man, but incomparably more rugged. Being of Tertiary volcanic origin, arising abruptly from the sea bed in deep water, it is mountainous throughout, reaching 1825 m and often meeting the sea with precipitous cliffs up to 600 m high. Accessible beaches and flat land for cultivation are scarce, but

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water is brought to wherever it is needed by means of an elaborate system of water channels (levadas) which may traverse mountains almost horizontally for long distances, providing excellent footpaths through otherwise intractable terrain. Though the climate is equable at all times of year, being virtually frost-free at sea-level, there is a well marked mist zone on mountains at about 600–1300 m, and many rocky gullies crossing the levadas provide excellent fern habitats where even delicate filmy ferns can sometimes be found growing in the open on the ground.

The name Madeira means 'wood' and when the island was first discovered in the fourteenth century it was forest-covered. After settlement in the fifteenth century much of the native forest was rapidly destroyed to provide timber and firewood but, under the guidance of an enlightened modern forestry service, a good deal of forest still remains, especially on the north side of the island between 600 and 1200 m. This forest, though doubtless not entirely virgin, nevertheless still contains the characteristic laurels (species of both *Laurus* and *Ocotea*) as well as other remarkable trees, such as *Clethra arborea* Aiton. An important subsidiary constituent is *Erica arborea* L. which can become locally dominant over considerable areas if the laurels are absent. Floristically, this forest, the laurisilva, is quite unlike any found in Europe today but it is clear that, in large measure, it resembles forests growing over much of Europe in Miocene and Pliocene times. Not unnaturally, the forest is also a luxuriant habitat for the larger ferns. Equally characteristic fern habitats include the crevices or surfaces associated with sun-baked rocks at sea-level which provide xerophytic conditions. At the other extreme, the special habitats associated with mountain-tops provide climatic conditions more reminiscent of Britain. A more detailed general description will be found in Benl (1971).

The taxonomic literature most relevant to the present communication includes Romariz (1953), Hansen (1969; 1970), and Eriksson et al. (1974) as revised by Hansen & Sunding (1979, 1985). The first is a pteridophyte flora of Madeira but each of the others is a checklist of all vascular plants known from the island. As we shall show, all these compilations are still in need of additions and nomenclatural modifications. Finally, *Flora Europaea* is relevant for the special reason that, alone among the Macaronesian archipelagos, the Azores are treated as European though Madeira is not. The validity or otherwise of this apparently arbitrary distinction will be discussed.

In addition to its own native flora, Madeira has been enriched by many introduced taxa which we have avoided as far as the facts have been ascertainable. Such adventives include the genera *Cyrtomium, Doodia, Microlepia, Nephrolepis,* and several species of *Pteris* and *Adiantum*. Disregarding these we now recognise 26 genera of leptosporangiate ferns as native to Madeira. Sixteen of these occur also in Britain though not always represented by the same species. The remaining genera have no British representative, though several are now known from continental Europe and one species of *Elaphoglossum*, though credited to Europe in *Flora Europaea* because of its presence in the Azores, is in fact limited to Macaronesia.

In contrast to adventives, we have been able to study for the first time several newly discovered native entities, including both species and hybrids. These additions, together with recent cognate discoveries in southern Europe, amplified by experimental studies carried out by other workers on selected genera (see especially *Cheilanthes* and *Dryopteris*), have not only deepened understanding of Madeira in particular and of Macaronesia in general, but have also greatly increased the evidence linking these islands with the Tertiary flora of mainland Europe.

Materials and methods

Adult specimens of most of the Madeiran ferns were collected personally and brought back to England alive during one or more of three visits carried out by one or other of the first two authors, who never visited the island together. The dates were:

1. A visit of three weeks in April 1949 by the senior author (I. Manton), accompanied by two members of the staff of the Botany Department at Leeds University. The plants from this journey were brought back by sea and established in cultivation in Leeds where, during the

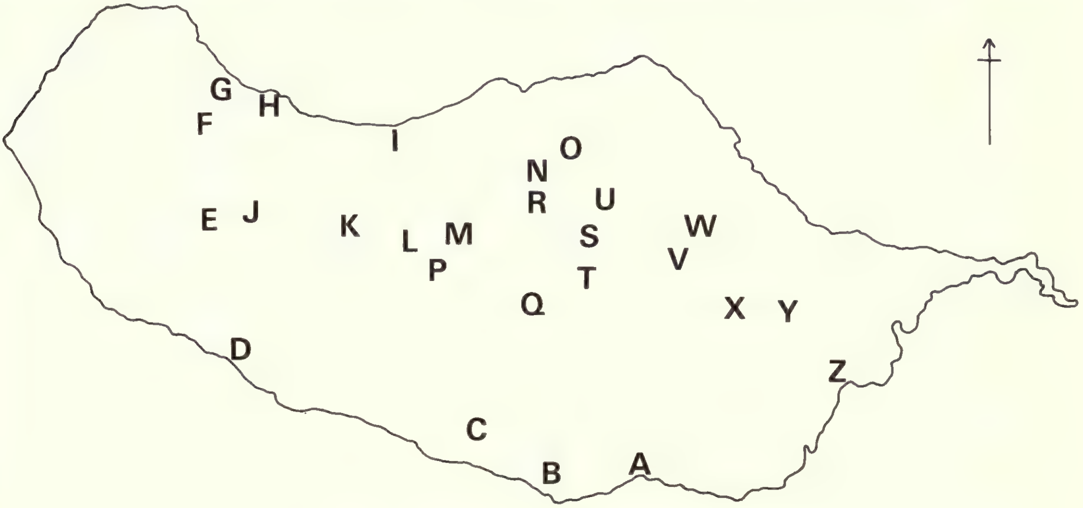
next few months, they gave cytological results to the extent of 91 per cent of the then known fern flora, as summarised in Manton (1950: 282).

2. A second visit carried out by one of the junior authors (J. D. Lovis) in April 1969 by invitation from Professor T. Reichstein of Basel, who also took part, accompanied by J. G. de Joncheere, to collect ferns, mainly *Asplenium*, *Dryopteris* (some for chemical analysis), *Hymenophyllum* and *Polystichum*. A special search for *P. drepanum* at Ribeiro Funda was successful.
3. A third visit, in July 1970, by J. D. Lovis alone, was specially directed to following up a limited number of unresolved problems, recognised as such from previous journeys.

   In addition, supplementary specimens of single taxa, not collected personally by any of the authors, will be found included in the list of results under the genera *Arachniodes*, *Asplenium*, *Culcita*, *Hymenophyllum*, and *Phyllitis*.

A herbarium record of the plants collected on the first journey was compiled at the time by W. A. Sledge (a member of the party) and voucher specimens, from parts of the actual plants used for cytology subsequently, were pressed by the senior author. Duplicates from the former and all the tally specimens from the latter are now in BM. In addition, the late A. H. G. Alston visited Leeds several times while work was in progress, to take herbarium specimens of plants likely to interest the British Museum, and these have already been incorporated into the national collections, with the relevant cytological facts and origin inscribed on the labels. The hybrid *Hymenophyllum* (see p. 138), collected on the first journey in the belief that it was *H. wilsonii*, is of special importance here because it eventually died out in Leeds before its peculiar nature had been effectively resolved and a tally specimen was not taken; Alston's sheet of specimens from this plant therefore remained the only herbarium record of it until the hybrid was collected again, from another locality, 20 years later (see Pl. V).

The cytological techniques used were those now standard for fern chromosomes (see Manton, 1950; Panigrahi & Manton, 1958; Roy & Manton, 1965; Manton & Vida, 1968, etc.). Several of



Map of Madeira showing plant locations.

Key to the sites on the map. A: Funchal, including lower slopes of Monte, 0<350 m; B: São Martinho, 250 m; C: Estreito de Camara de Lobos, 150<400 m; D: Madalena do Mar, 300 m; E: Rabaçal, 975<1100 m; F: Alagoa, Levada do Fanal, 1080 m; G: Ribeiro Funda, 200<250 m; H: Seixal, 80 m; I: São Vicente, 0<500 m; J: Levada do Moiro, above Levada da Rabaçal, 1400–1550 m; K: Pico do Cedro (1 km W of Boca da Encumeada), 1000 m; L: Boca da Encumeada, 1000 m; M: Pico do Tapeiro, 1225 m; N: Pico do Ferreiro, 1500 m; O: Pico Casado do Partiera, 1600<1650 m; P: Serra d'Água, 600 m; Q: Curral das Freiras (Gran Curral), 400<1000 m; R: Caldeirão Verde, 1000 m; S: Pico Ruivo de Santana; T: Pico do Arieiro, 1575 m; U: Queimadas, 875 m; V: Ribeiro Frio, 850<875 m; W: Pau Bastião, above Levada do Cedro Gordo, 400 m; X: Levada da Serra do Faial, West of Santo da Serra, 800 m; Y: Santo da Serra, 650 m; Z: Santa Cruz, 25 m.

the preparations used for illustrations date back to 1949 or were added subsequently by the senior author on the same plants in cultivation, but many taxa have been re-worked by one or other of the junior authors, sometimes on the original plants but often on more recent gatherings. The junior authors between them have been entirely responsible for handling the additions to the flora not included in Manton (1950) and also for all the mitotic squashes. Satisfactory techniques applicable to ferns (as opposed to flowering plants) did not exist for this purpose before the enzyme method introduced by Chambers (1955) became available. This has been replaced recently by treatment of fixed roots with warm acid (N.HCl at 60°C for 20 min.) to permit the cells to be separated before staining; this is the method currently in use by M. Gibby (see Gibby, 1985*a, b*).

In presenting the results we have supplied photographic authentication of the cytology of almost all the species mentioned in the text, using the standard magnification of 1000 diameters (with a few exceptions) in conformity with previous practice. In arranging the illustrations, we have followed as closely as possible the taxonomic order used by Hansen (1969) but elsewhere, in the explanatory notes and list of results, it has seemed more convenient to arrange the genera and species alphabetically. Cross-reference between one system and the other is provided by the inclusion of figure and plate numbers against each taxon in the list below. Finally, a map with a list of marked localities is appended.

Alphabetical list of taxa with data

[ ] Counted only from other areas.

Genus	Species	2n	n	Locality and date	Map	Fig.	Pl.
Adiantum							
	capillus-veneris L.	*c.*60	30	Funchal, 1949	A	4a	I
		60	30	São Martinho, 1969	B	4b	I
	reniforme L.	—	150	Estreito, 1949	C	—	
		300	150	Estreito, 1969	C	5a	I
		300	150	Cedro Gordo, 1969	W	5b	I
		—	150	Seixal, 1970	H	—	
Anogramma							
	leptophylla (L.) Link	—	27±1	Monte, 1949	A	8a–c	II
Arachniodes							
	webbianum (A. Braun) Schelpe	—	41	Kew, locality unknown	—	34a	VIII
		82	—	Rib. Funda, 1969	G	34b	VIII
Asplenium							
	aethiopicum (Burman f.) Bech.	—	216	Rib. Frio (cf. Braithwaite, 1964*a*)	V	—	
		—	216	Santa da Serra, 1949	Y	—	
		—	216	Cedro Gordo, 1969	W	—	
		—	216	Seixal, 1970	H	29	VII
	anceps Lowe ex Hook. & Grev.	—	36	Santa da Serra, 1969	Y	22	VI
		—	36	Rib. Frio (*Joncheere*, 1969)	V	—	
		—	36	Pico do Ferreiro, 1970	N	—	
		—	36	Queimadas, 1970	U	—	
		—	36	Pico do Arieiro, 1969	T	—	
		—	36	Rabaçal, 1969	E	—	
		—	36	Caldeirão Verde, 1969	R	—	
	billotii F. Schultz	—	72	São Martinho, 1949	B	—	
		—	72	Santa da Serra, 1969	Y	24	VI
	hemionitis L.	*c.*72	—	Rib. Frio, 1949	V	—	
		—	36	Seixal, 1970	H	28	VI

Alphabetical list of taxa with data—*Cont.*

[ ] Counted only from other areas.

Genus	Species	2n	n	Locality and date	Map	Fig.	Pl.
	marinum L.	—	36	Funchal, 1949	A	—	
		—	*c.*36	São Vicente	I	27	VI
	monanthes L.	108	108	Rib. Frio, 1949, 1970	V	20a,b	VI
	onopteris L.	72	36	Rib. Frio, 1949, 1970	V	—	
		—	36	Pico Casado, 1970	O	26	VI
		—	36	Queimadas, 1970	U	—	
	septentrionale (L.) Hoffm.	[*c.*144	—	Teneriffe, coll. *Benl*]	—	25	VI
	trichomanes subsp. *quadrivalens* D.E. Meyer emend Lovis	—	72	Gran Curral, 1949	Q	—	
		144	—	Rib. Frio, 1949	V	—	
		—	72	Caldeirão Verde, 1969	R	21	VI
		—	72	Rabaçal, 1969	E	—	
		—	72	Pico Casado, 1970	O	—	
		—	72	Pico do Arieiro, 1969	T	—	
		—	72	Serra d'Água, 1969	P	—	
	sp.	*c.*216	108	Pico do Ferreiro, 1970	N	23	VI
Athyrium							
	filix-femina (L.) Roth	—	40	Rib. Frio, 1949	V	35	VIII
Blechnum							
	spicant (L.) Roth	68	—	Rib. Frio, 1949	V	—	
		—	34	Encumeada, 1970	L	45	X
		—	34	Pico do Arieiro, 1969	T	—	
Ceterach							
	[*aureum* (Cav.) Buch	—	72	Teneriffe, 1949]			
	[*aureum* var. *parvifolium* Benl & Kunkel	—	*c.*144	Canaries, 1969]			
	sp.	—	*c.*100	São Martinho, 1949	B		
		—	108	Serra d'Água, 1969	P	31	VII
Cheilanthes (excluding *Notholaena*)							
	maderensis Lowe	—	*c.*30	São Martinho, 1949	B	3	I
Christella							
	dentata (Forssk.) Brownsey & Jermy	—	72	Locality lost	—	12	III
Culcita							
	macrocarpa C. Presl	136	68	Madeira (Kew),	—	9a,b	II
		[—	66-8	Azores, *c.* 1950]	—		
		[*c.*136	—	Azores, 1984]	—	9c	II
Cystopteris							
	fragilis var. *diaphana* (Bory) C. Chr.	—	126	Pico Ruivo, 1949	S	—	
		—	126	São Vicente, 1949	I	32	VIII
		—	126	Rib. Frio, 1949	V	—	
		—	126	Pico do Arieiro, 1969	T	—	
Davallia							
	canariensis (L.) Sm.	—	40	Encumeada, 1949	L	10	III

Alphabetical list of taxa with data—*Cont.*

[ ] Counted only from other areas.

Genus	Species	2n	n	Locality and date	Map	Fig.	Pl.
Diplazium	*caudatum* (Cav.) Jermy (*Athyrium umbrosum* (Aiton) C. Presl)	—	40-41	Father Costa's garden, 1949		—	
		—	*c.*41	Rib. Frio, 1949	V	—	
		82	—	Cedro Gordo, 1969	W	33	VIII
Dryopteris	*aemula* (Aiton) Kuntze	—	41	Rib. Frio, 1949	V	38a	VIII
		82	—	Encumeada, 1970	L	38b	
		—	41	Pico do Arieiro, 1970	T	—	
	affinis (Lowe) Fraser-Jenkins subsp. *affinis* (*D. borreri* Newman)	*c.*82	82	Rib. Frio, 1949	V	39a,b	IX
	aitoniana Pichi-Serm.	*c.*82	41	Rib. Frio, 1949	V	37	VIII
	maderensis (Milde) Alston	—	41	Queimadas, 1949	U	36	VIII
		—	41	Santo da Serra, 1969	Y	—	
Elaphoglossum	*semicylindricum* (T. Bowdich) Benl	164	—	Pico do Cedro, 1969	K	44	X
Hymenophyllum	*tunbrigense* (L.) Sm.	—	13	Santa da Serra, 1949	Y	—	
	Sm.	—	13	Rib. Frio, 1949	V	15b	IV
		—	—	Pico do Tapeiro	M	15a	IV
	wilsonii Hook.	—	18	Alagoa. Levada do Fanal (coll. *Benl*, 1970)	F	16a,b	IV
		62	31	Queimadas, 1970	U	17a-c	IV
	sp. × *wilsonii*	—	irregular (*c.* 18 pairs 12–13 singles)	Queimadas, 1949	U	18a-c	V
		49	ditto	Pico do Tapeiro, 1969, 1970	M	19a-c	V
Notholaena (Cheilanthes)	*lanuginosa* (Desf.) Desv. ex Poiret (*Cheilanthes vellea* F. Muell.)	—	58	Santa Cruz, 1949	Z	2	I
	marantae subsp. *subcordata* (Cav.) Benl & Poelt	58	—	see text		text	p.138
		—	*c.*29	Madalena do Mar, 1969	D	1	I
Oreopteris	*limbosperma* (All.) Holub	—	34	Queimadas, 1949	U	—	
		—	34	Encumeada, 1970	L	13	III
Phyllitis	*scolopendrium* (L.) Newman	—	36	Levada do Moiro (*Pickering*, 1970)	J	30	VII

Alphabetical list of taxa with data—*Cont.*

[ ] Counted only from other areas.

Genus	Species	2n	n	Locality and date	Map	Fig.	Pl.
Polypodium							
	macaronesicum A. Bobrov	74	—	Rib. Frio, 1949	V	47c	XI XII
		—	37	Rib. Frio, 1970	V	47a	XI
		74	37	Levada dos Toros, 1985	A	47b	XI
		74	—	near Porto Santo, 1985	—	—	
	vulgare L.	—	74	Pico Ruivo, 1949	S	—	
		—	74	Pico do Arieiro, 1970	T	—	
		—	74	Pico Casado, 1970	O	48	XI
	interjectum Shivas	—	111	Pico Ruivo, 1949	S	49	XI
Polystichum							
	drepanum (Sw.) C. Presl	—	82	Rib. Funda, 1969	G	40	IX
	falcinellum (Sw.) C. Presl	*c.*328	164	Encumeada, 1949	L	41	IX
	setiferum (Forssk.) Moore ex Woynar	*c.*82	—	Rib. Frio, 1949	V	—	
		—	41	Encumeada, 1949	L	42	IX
	setiferum × *falcinellum*	205	irregular	Rabaçal, 1969	E	43a,b	IX
Pteridium							
	aquilinum (L.) Kuhn	—	52	Wild fix, 1949, locality not recorded	—	6	II
Pteris							
	palustris Poiret (*P. arguta* Aiton)	58	29	Encumeada, 1949	L	7	II
Stegnogramma							
	pozoi (Lagasca) Iwatsuki (*Leptogramma totta* (Willd.) Sm.; *L. africanum* (Desv.) Ching)	—	72	Rib. Frio, 1949	V	14	III
Trichomanes							
	speciosum Willd. (*T. radicans* Sw.)	—	72	Santo da Serra, 1949	Y	—	
		—	72	Rib. Frio, 1949, prep. 1970	V	11	III
Woodwardia							
	radicans (L.) Sm.	68	*c.*34	Encumeada, 1949	L	46a	X
		[—	34	Azores]	—	46b	X

Notes on genera

Adiantum (Pl. I)

The well known maidenhair-fern, *A. capillus-veneris*, provides a convenient basis for cytological comparisons; in Europe and elsewhere this species is interpretable as diploid with n = 30, 2n = 60 (Figs 4a, b). In contrast, *A. reniforme* is one of the most remarkable ferns in the Macaronesian flora. Outstanding attributes are its undivided, orbicular leaves, high chromosome number (at least in Madeira), and fragmented geographical range. The high chromosome number (n = 150) was first recorded in Manton (1950) on the basis of two different counts, one from a recently collected plant from Madeira and the other from a better established specimen, long in cultivation at Kew, and purporting to have come from Teneriffe (Canary Islands). The accuracy of the count itself, for Madeira, has since been confirmed several times by the junior authors following more recent collections from the island (see Figs 5a, b). These also indicate normal sexual reproduction (see especially Fig. 5b showing the full decaploid count of 2n = 300). However, a recent publication by Page (1973) concerning chromosome numbers for some (though not all) ferns from the Canary Islands, while explicitly mentioning *A. reniforme* in one context, states in another that no grades of ploidy higher than 6× occur for any fern in this archipelago. This necessarily raises a query against the previous citation for Teneriffe (Manton, 1950) and re-examination of the evidence shows that the count itself was excellent but the source of the plant could have been mistaken. Since the original Kew records dating back to 1949 no longer exist, the putative origin of this plant as from Teneriffe cannot now be verified and may have been wrong. We have, therefore, expunged this particular record while retaining, as authentic, the statements concerning Madeira. Fortunately, in 1985 a more recent introduction to Kew (accession number 226-79.02237) genuinely from the Canaries, was successfully investigated cytologically by M. Gibby who obtained an unambiguous tetraploid count of n = 60. There is no doubt, therefore, that even within Macaronesia, *A. reniforme* sens. lat. is a complex and not a single taxon.

Outside Macaronesia, *A. reniforme* has been reported from a few isolated stations in Africa, notably Kenya (Verdcourt, 1962; see also Bramwell, 1976: 235), while a similar species, *A. asarifolium* Willd., has long been known from the Mascarene Islands (e.g. Réunion). In addition, Tardieu-Blot (1946, 1958) has claimed that this taxon also occurs in Madagascar, though she regards *A. asarifolium* as conspecific with *A. reniforme*. Whatever the truth may be here, there seems little doubt that the species (or complex) must relate back to former populations with a more continuous range than at present. That this range also includes China has recently been established by Lin (1980) who has published an excellent drawing accompanying descriptions in Latin and Chinese for *A. reniforme var. sinense* Y.-X. Lin from eastern Sichuan, at Wan Xian, alt. 350 m. The former presence of *A. reniforme* sens. lat. in Europe as claimed by Saporta (1865, 1869) and Saporta & Marion (1876) on fossil evidence from Meximieux near Lyons in the Rhone Valley should thus occasion no surprise, even though confirmation (cf. Depape, 1922) is doubtless still desirable and may require fresh collecting since the present whereabouts of the original Pliocene fossils is apparently unrecorded (C. Hill, personal communication).

Anogramma (Pl. II)

Members of this genus are annuals and the cosmopolitan *A. leptophylla* representing it in Madeira is no exception. This is one reason for difficulty in establishing the species in culture, even though the prothalli are potentially perennial. The cells are small and the chromosomes minute (Fig. 8a–c). They are also stated by several authors to be difficult to study and special reasons for this difficulty (stickiness, a tendency towards clumping, and the peculiar morphology of two chromosomes in the haploid complement) have been described and illustrated by Baroutsis & Gastony (1978).

Gastony & Baroutsis (1975) and Baroutsis & Gastony (1978) enumerate all known chromosome counts within the genus. These (cf. Walker, 1966) include several species with n = 29, though one of these involved a taxon subsequently removed from the genus and another has n = 27 (Mickel et al. 1966). Polyploidy at the tetraploid level has been found several times, notably in two species from South America (Gastony & Baroutsis, 1975) and in *A. leptophylla* for India, though at first only approximate counts were provided for the latter. Thus Mehra & Verma (1960) record n = 56–7, while Verma & Khullar (1965) quote n = *c*.58. This count has nevertheless recently been amended to n = exactly 58 by Khullar (verbal communication in 1985 via Reichstein). An aberrant number has been listed by Fabbri (1963) quoting Tutin as 'n = 26 ?'

from the island of Jersey (U.K.), though without other authentication. This number (n = 26) has also been given by Kurita (1971) for a European specimen of supposedly the same species, though without full geographical details.

It is therefore the case that apparently unambiguous counts of n = 29 for *A. leptophylla* are limited to the southern hemisphere, notably by Brownlie (1958) for New Zealand and by Baroutsis & Gastony (1978) for South Africa. Lower numbers, including n = 26, could exist in other areas, but without fuller authentication this cannot be known with certainty. Herein of course lies the potential importance of Madeira. Unfortunately, an unambiguous count has so far eluded us. The chromosomes are minute (Figs 8a–c) and their number, though of the same order as those recorded from other areas, seems to us unlikely to be as low as 26*. We have therefore expressed it as n = *c*.27±1.

Arachniodes (Pl. VIII)

The endemic *A. webbianum*, sole representative of its genus in Madeira, was attributed to *Polystichum* by Romariz. It is diploid with n = 41 (Fig. 34a) established with reasonable certainty from a Kew plant of unknown wild origin, supplemented by a root tip count of 2n = 82 (Fig. 34b) from a specimen from Rib. Funda. This number is, of course, common in several related fern genera including *Polystichum* and *Dryopteris* (Manton, 1950).

Asplenium (Pls VI, VII)

This is the largest genus of ferns in Madeira, even without the additions of *Phyllitis* and *Ceterach*, both sometimes included within it but treated separately here. Among so many species it is not difficult to detect participation from many different geographical sources.

Asplenium aethiopicum is a member of a species-complex (see for example Manton, 1959) extending in one direction to the West Indies, and in the other to Sri Lanka and Australia, but having its greatest development in East and southern Africa. The African complex was the subject of an experimental investigation by Braithwaite (1964*a*, *b*), who demonstrated an autoallopolyploid complex based on x = 36 and involving not only tetraploid, octoploid, and dodecaploid sexual cytotypes, but also hexaploid, octoploid, and decaploid apomicts. Apomictic hexaploids have been found in the Canaries (Braithwaite, personal communication) but Madeiran representatives (Fig. 29 with n = 216) are undoubtedly sexual dodecaploids (Panigrahi, 1963; Braithwaite, 1964*a* etc.) and not octoploids as stated on incomplete evidence by Manton (1950: 283, 304). Dodecaploids are known elsewhere, in Africa (Braithwaite, loc. cit.). It is therefore plain that the Madeiran plants must represent an outlying relict of a complex which evolved in continental Africa and not a high polyploid which originated on the island.

Asplenium billotii (Fig. 24), *A. marinum* (Fig. 27), and *A. onopteris* (Fig. 26), all species of Atlantic and/or Mediterranean distribution, possess the same chromosome numbers in Madeira as those previously demonstrated in Europe. *A. billotii* is tetraploid (n = 72) and the other two are diploid (n = 36) as is *A. hemionitis* (Fig. 28), a species occurring in Europe only near Lisbon.

Asplenium trichomanes aggregate. This complex has a worldwide distribution, the two most important members being subsp. *trichomanes* (diploid) and subsp. *quadrivalens* (tetraploid); see Lovis (1964). In Madeira, as elsewhere in Macaronesia, only the latter is at present known as correctly reported by Hansen & Sunding (1985); see also Fig. 21. In addition, two other members of the *A. trichomanes* group sens. lat. (*A. anceps* and *A. monanthes*) have been known on the island for a long time, though *A. anceps* was often confused with *A. trichomanes* sens. strict. or classified as a subspecies of *A. trichomanes*. We shall report on this problem and add an additional (new) taxon (see below), but enumerate our own observations first.

Thus our earliest specimen, collected in 1949 from Rib. Frio, was both cytologically and morphologically indistinguishable from European *A. trichomanes* subsp. *quadrivalens*, a tetraploid of somewhat variable appearance. In contrast, a few years later some distinctive specimens were collected by G. J. de Joncheere, also from Rib. Frio, and sent by him to one of us for study. Later in 1966, two living plants from the same de Joncheere gathering were sent to us from Berlin by the kindness of the late D. E. Meyer. One of these proved to be diploid with n = 36, though the other did not survive. Morphologically, all de Joncheere's specimens were not only distinct from *A. trichomanes* subsp. *quadrivalens* but were also in close agreement with type material of *A. anceps* Lowe, still retained in the herbaria at Kew and the BM.

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* A recent count made on field fixings collected by J. F. M. Cannon & M. J. Cannon in Madeira gives n = 26 (Gibby, 1986).

Recent use of the name '*A. anceps*' had become thoroughly confused by its association as a varietal epithet with a form of *A. trichomanes* subsp. *quadrivalens* found not uncommonly on the oceanic fringes of continental Europe and characterized by exceptionally long pinnae. Elsewhere, in mainland Europe, the pinnae of this variable subspecies are generally much shorter, while those from Madeira are shorter still. Nevertheless, all forms of *A. trichomanes* can be distinguished from *A. anceps* by a suite of characters described in detail elsewhere (Lovis et al., 1977: 87–88, and see also illustration in Rasbach et al., 1981). For *A. anceps* itself we have not only Lowe's original specimens together with an accurate description of them (Lowe, 1831) but also a contemporary illustrated description of the species by Hooker & Greville (1830–31). The identity of Lowe's taxon is therefore not in doubt and we can accept the name as valid and applicable to our own Madeiran diploid.

Both *A. anceps* (diploid Fig. 22) and *A. trichomanes* subsp. *quadrivalens* (tetraploid Fig. 21) were further investigated in the field in 1969 and 1970 and found to differ considerably in their ecological attributes, though they are not mutually exclusive. *A. anceps* is calcifuge and avoids direct sunlight, preferring the shade of light forest, often at fairly high altitudes and in moist conditions, sometimes approaching those appropriate to filmy ferns, on the banks of levadas. *A. trichomanes* subsp. *quadrivalens*, in contrast, is not calcifuge. It can often be found in south exposed sunny places at lower altitudes and on any kind of rock, including limestone and mortared walls, being able to withstand more exposed and drier conditions.

A. anceps is not known outside Macaronesia though it is not confined to Madeira. Its existence in the Azores and Canaries has recently been confirmed and cytologically investigated specimens from both archipelagoes have also been shown to be diploid (Lovis et al., 1977; Rasbach et al., 1981). Outside Macaronesia, the nearest relative of *A. anceps* is *A. tripteropus* Nakai (diploid) from Japan (Tatuno & Kawakami, 1969). Recent gatherings of it from China and Taiwan have confirmed the diploid condition (Reichstein, personal communication). *A. tripteropus* agrees with *A. anceps* in possessing a three-winged rachis (hence its name) but differs in possessing prostrate (not erect) fronds, which are proliferant apically, thinner in texture, dull grey-green in colour and with a matt surface, as opposed to bottle-green and shining as in *A. anceps*. Such characters, apart from proliferations, are not normally evident in herbarium specimens. This explains why Nakai, after having seen dried material from Macaronesia for the first time (Nakai, 1933) felt compelled to reduce his species to a variety of *A. anceps*, as var. *proliferum*, an interpretation that we do not accept. In our view, both *A. anceps* and *A. tripteropus* deserve specific status though they may well share a common origin somewhere in Eurasia. The present restriction of *A. anceps* to Macaronesia is surely relictual and, as a natural component of the laurisilvan ecosystem, *A. anceps* was probably present in Europe in the late Tertiary.

From the known constitution of *A. trichomanes* subsp. *quadrivalens*, the hybrid between this and *A. anceps* should be triploid (= TrTrAn). Search for such a hybrid in Madeira was unsuccessful, but one plant, collected fortuitously from a horizontal crevice on Pico do Ferreiro, proved to be hexaploid (Fig. 23) with regular chromosome pairing (n = 108). This plant is therefore likely to have been an amphidiploid between *A. trichomanes* subsp. *quadrivalens* and *A. anceps* and to have the constitution (TrTrAn)×2. Confirmation of this supposition is currently being sought by Professor Reichstein who has living progeny from a new gathering, identified on the basis of its morphology. The hexaploid condition has recently been confirmed (Reichstein, personal communication) and attempts will therefore be made to synthesise the back-cross to *A. anceps*.

The original hexaploid (Fig. 23) plant, or population, covered a considerable length of its fissure and was clearly of great age. It is perhaps comparable in some ways with *A. eberlei* D. E.

Meyer, an amphidiploid derivative of *A. rutamuraria* subsp. *dolomiticum* Lovis & Reichstein and *A. seelosii* Leybold in Europe, which is known in the wild only as a few individuals in one station (Eberle, 1967; Meyer, 1967). Such amphidiploids may occasionally be reformed in nature though they are not vigorous enough to persist indefinitely or to spread far from their points of origin.

A. monanthes, the last member of the *A. trichomanes* group as enumerated above, poses fewer taxonomic problems. It is an obligate apomict in Madeira as also in Tristan da Cunha (Manton & Vida, 1968) and the Azores (Vida in Lovis et al., 1977: 85) in all of which it is triploid (n = 108, 2n = 108), as also in Mexico, though a tetraploid cytotype is also recorded from Mexico by Smith & Mickel (1977). Whether the latter is sexual or apogamous is unknown, but we illustrate the Madeiran triploid by means of the two sorts of sporangia produced concurrently by such apomicts. Thus Fig. 20a shows chromosome pairing in a form expressing the true chromosome homologies and including many univalents among pairs in a '16 celled sporangium'. Such sporangia produce only bad spores. Fig. 20b in contrast, shows the full complement of 108 pairs preceding formation of diplospores in an '8 celled sporangium' on which reproduction solely depends. This type of reproduction was described and illustrated in other taxa in Manton (1950).

The only other species of *Asplenium* positively recorded in Madeira is *A. septentrionale* known from a single locality, remote and difficult of access, on the Passada da Vacas; it was discovered there by Manuel de Nobrega in 1951. Live material has not been available to us, but, by the kindness of Padre Nobrega, we have had access to the original herbarium material in the Museo de Seminario do Funchal and this, in gross morphology and in spore size, agrees with *A. septentrionale* subsp. *septentrionale*, widespread in Europe and everywhere tetraploid. In contrast, the diploid *A. septentrionale* subsp. *caucasicum* Fraser-Jenkins & Lovis is morphologically distinct and known at present only from the Caucasus, Turkey, and perhaps Pakistan (Reichstein, personal communication). An additional specimen of subsp. *septentrionale*, provided by Dr Benl from Teneriffe, was similar in appearance to that in the Funchal museum and it has proved to be tetraploid (2n = 144, Fig. 25). It is therefore reasonable to assume that *A. septentrionale* in Madeira will also be tetraploid.

A. adiantum-nigrum L., though as yet unrecorded in Madeira, is common in certain parts of the Azores and present, though rare, in the Canaries (Reichstein, personal communication). Specimens from both sources have been shown to be tetraploid as in Europe (G. Vida, unpublished) and it is therefore possible that this taxon, in its usual form, may also eventually have to be added to the Madeiran list.

Athyrium (Pl. VIII)

The monoploid chromosome number, n = 40 (Fig. 35) now known to be characteristic of this genus, was first discussed by Manton (1950) as a means of separating *Athyrium* from *Asplenium* (n = 36) with which the soral characters had previously been confused. It was later discussed (Manton & Sledge, 1954) in a comparable manner in relation to *Diplazium* (n = 41), a distinction which is still valid in Madeira.

Blechnum (Pl. X)

This genus is cytologically more diverse outside Europe than within Europe. In a geographical distribution which includes Africa, India, Japan, Jamaica, Tristan da Cunha, etc., a range of base numbers from 28 to 36 is known to exist (see, for example, Walker, 1966; Manton & Vida, 1968, etc.). In Europe, as in Madeira (Fig. 45), only one chromosome number (n = 34) has been found and this is also historically important as a critique on Bower's earlier phyletic views connecting *Blechnum* and *Phyllitis* (n = 36) which were not upheld (cf. Bower, 1928; Manton, 1950).

Ceterach (Pl. VII)

This distinctive genus of Asplenioid ferns (for a recent discussion see Bir et al., 1985) has proved to be cytologically complex in Macaronesia. The ordinary European *C. officinarum* Lam. & DC. [usually tetraploid (Manton, 1950), but sometimes diploid (Vida, 1963)] is not positively recorded from Macaronesia, but its former presence, at least in the Canaries, is suggested by the morphology of some representatives of *C. aureum* sens. lat. from these islands. *C. aureum* sensu stricto is thought to be a Canarian endemic and when collected first by us in Teneriffe in 1949 (on the return journey from the first visit to Madeira, see p. 124 above) it was found to be tetraploid (Manton, 1950). Putative equivalents from Madeira were later found to be hexaploid (Fig. 31), while several additional specimens from the Canaries were recorded by G. Vida and others as octoploids (notably TR 1929, 2540 from Gran Canaria, TR 4650 from Teneriffe, and TR 5075 from Palma). The latter were attributed taxonomically to *C. aureum* var. *parvifolium* (Benl & Kunkel, 1967) a taxon clearly distinguishable from *C. aureum* var. *aureum* (though not from *C. officinarum*) by spore size. In other respects the morphology of the octoploids was consistent with a possible origin, by chromosome doubling, from a tetraploid hybrid between *C. aureum* var. *aureum* and *C. officinarum*.

In order to begin to explore this situation experimentally, a hybrid was synthesized by G. Vida between *C. aureum* var *aureum* (tetraploid = TR 1932) and var. *parvifolium* (octoploid = TR 1930), both from the Canaries. This hybrid was hexaploid as expected and not easily distinguishable morphologically from the Madeiran hexaploids though it was slightly less fertile. The spores were mainly good but a little aborted material was usually present among them (never found in the wild hexaploids) and chromosome pairing was less regular. Several multivalents and univalents seemed always to be present, among a majority of bivalents. One fully analysed nucleus that can be cited as a sample gave: $4_{iv}, 6_{iii}, 88_{ii}, 6_{i} = 216$. No mother cells with exactly 108 bivalents were found. An auto-allopolyploid origin for *C. aureum* var. *parvifolium* was inferred from these findings.

These, and other observations will be published in greater detail by Reichstein & Vida but fuller interpretation is impossible without additional evidence. Synthesis of other types of hybrid will almost certainly be needed for this purpose. In the meantime, the Madeiran hexaploid will be formally described elsewhere as a new taxon.

Cheilanthes (Pl. I)

Former concepts of this genus are no longer tenable, including that of Romariz (1953). Two former species (*C. catanensis* (Cosent.) H. P. Fuchs = *C. vellea*, and *C. marantae*) will therefore be treated below under *Notholaena* (as *N. lanuginosa* and *N. marantae* respectively) in agreement with Badré & Reichstein (1983). The taxonomic treatment of the remaining species follows the cytogenetic work of Reichstein, Vida and associates (e.g. Vida et al., 1970; Reichstein & Vida, 1973; Rasbach & Reichstein, 1982; Rasbach et al., 1983; Vida et al., 1983, etc.).

The taxa studied in this way are listed below. All are present in southern Europe but the initial letters m and c (denoting Madeira or Canaries) indicate the Macaronesian distribution.

Diploids	Tetraploids
mc. *C. maderensis* Lowe	mc *C. tinaei* Tod.
C. hispanica Mett.	*C. acrostica* (Balbis) Tod.
C. persica (Bory) Mett. ex Kuhn.	(= *C. pteridioides* auct., non (Reichst.) C. Chr.)
c *C. pulchella* Bory	mc *C. guanchica* Bolle

The synonymy of *C. maderensis* and '*C. pteridioides*' is complex and it is therefore perhaps important to draw attention to two recent publications by Nardi & Reichstein (1985, 1986) dealing explicitly with this topic. It is enough to say here that *C. maderensis*, with n = 30 (Fig. 3), listed as *C. fragrans* subsp. *maderensis* Lowe by Hansen (1969) and as *C. pteridoides* (sic)

(Reichard) C. Chr. by Romariz (1953), has proved to be an important parent of polyploids, having given rise, in combination with the other three diploids, to all three listed tetraploids. Among these, *C. guanchica* when first recognized was believed to be an autochthonous Canarian endemic though it has since been detected in NW. Africa and in S. Europe (Rasbach et al., 1977) and, even more recently, in old herbarium material from Madeira (Nardi et al., 1978: 12; Rasbach et al., 1982). The same authors have also recorded *C. tinaei* alive in Madeira. Though cytological observations have not been carried out on Madeiran specimens of either of the last two species, there is no reason to suggest that they are likely to be anything other than tetraploid.

Thus Madeira itself contains two of the three known tetraploids but only one diploid (*C. maderensis*). This situation is consistent with the general interpretation formulated by Vida et al. (1983), namely that a complex of related taxa, including all those listed above, evolved first in Mediterranean Europe and spread thence to Africa and Macaronesia. On this view the status of *C. pulchella* (diploid) in the Canaries would be that of a relict and its former presence in Europe would have to be assumed. The validity of this supposition has recently been confirmed (Perez-Carro et al., 1985) by the discovery of *C. pulchella* in NW. Spain. Similarly *C. guanchica*, an allotetraploid, could be relictual in Macaronesia though local re-synthesis is not excluded, and the diploid hybrid involving the two parental species has in fact been found alive in the Canaries (= *C.* × *teneriffae* Rasbach & Reichstein, 1982).

We have discounted, in agreement with Rasbach & Reichstein (1982), the possibility that any of these taxa could have been introduced into Macaronesia by man, even though several are now known only from single localities. Though in several cases the local habitat is man-made (e.g. walls in the vicinity of Funchal) old herbarium records exclude the possibility that any of these taxa could be recent arrivals. All could have existed on natural rock formations preceding human interference.

Christella (Pl. III)

C. dentata (formerly *Cyclosorus dentatus*) is tetraploid ($n = 72$, Fig. 12) as reported elsewhere (Manton & Sledge, 1954). It belongs to a virtually cosmopolitan tropical complex studied experimentally by Panigrahi & Manton (1958) and by Ghatak & Manton (1971). The exact locality in Madeira sampled in 1949 seems not to have been recorded; the species under an older generic name *Lastrea* is said to be uncommon but widespread on the island (Romariz, 1953).

Culcita (Pl. II)

This interesting Dicksonioid genus is represented in Madeira by a single species, *C. macrocarpa*, described by Romariz as present in central and southern Europe though it is also now known in Spain (for details see Molesworth-Allen, 1977). In Madeira it is almost extinct though still relatively abundant in the Azores. Our own sources have been restricted to specimens of known origin growing at Kew, one from the Azores and another from Madeira. The latter is represented by Figs 9a, b (by G. Vida) who also recorded roots from the same individual. A root from the Azorean specimen (accession no. 377-70.03704) recorded recently (1985) by M. Gibby is illustrated in Fig. 9c. Meiosis had also been initially studied by I. Manton (see Manton, 1958) though all three observers found it difficult. The general consensus is nevertheless in favour of $n = 68$, $2n = 136$, and G. Vida's earlier estimate of $n = c.66$ quoted by Holttum (1981: 563) and elsewhere is now withdrawn.

Other related genera, all with high chromosome numbers, include *Cibotium* ($n = 68$, illustrated in Manton, 1958), *Cyathea* ($n = 69$, see Walker, 1985), *Dicksonia* ($n = 65$, from many determinations cf. Walker, 1973), and *Cystodium* ($2n = 112$, $n = 56$, illustrated in Roy & Holttum, 1965). Preliminary observations on a species of *Culcita* subg. *Calochlaena* are given by Holttum (1963: 70, quoting Manton unpublished), though this cannot now be finalized without a fresh start. An additional member of subgenus *Calochlaena*, namely, *C. villosa* C. Chr., is nevertheless quoted by Holttum (1981: 563) on the basis of an unpublished record of $2n = 232$ by G. Vida. This number was interpreted as that of a tetraploid on $x = 58$ (see also Walker, 1984:

100 for evidence of n = 56 in this group). There seems little doubt, therefore, that base numbers lower than x = 68 do exist within this group of genera and it is pertinent to note that Copeland (1947) regards *Culcita* as more closely related to *Cystodium* (x = 56) than to *Dicksonia* (x = 65). For all these reasons it seems unlikely that *C. macrocarpa* (n = 68) can be interpreted as diploid, though its exact grade of ploidy cannot as yet be established.

Cystopteris (Pl. VIII)

Four gatherings of *C. fragilis* sens lat. from Madeira were examined cytologically; all gave n = 126. This number is familiar in Europe as is that of hexaploids within this complex (Manton, 1950), though other cytotypes, encountered outside Madeira, include tetraploids (with several taxonomically distinguishable representatives), a diploid (non-European), and an octoploid (Vida, 1972). Within the complex as a whole, in almost all areas, the speciation and naming are difficult and controversial. Thus Romariz (1953) lists only *C. fragilis* without qualification, but Hansen (1969) puts a question mark after this specific name while including *C. diaphana* (Bory) Blasdell as a good species present on the island, together with a putative hybrid with *C. fragilis* itself. However, Vida (1974) notes that 'Diaphana' types in Europe are restricted to the Mediterranean territories, but the presence of many transitional types suggests that subspecific rank (as *C. fragilis* subsp. *diaphana*) is the most likely to be correct. Hexaploids closely resembling those from Madeira have also been found in the Canaries (notably TR 2339 from Palma and TR 2856 from Gran Canaria), while others, slightly larger but only marginally different otherwise, have been recorded from Chile (Reichstein, personal communication). The latter include TR 3912 from Prov. de Talca and TR 3913 from Prov. de Conception. For further information on the mutual relationships among some of the many known types see Vida (1976) and Vida & Mohay (1980).

Davallia (Pl. III)

A chromosome count of n = 40 was first illustrated in this genus for a non-European species in Sri Lanka (Manton & Sledge, 1954), although the presence of one rather large chromosome-pair left open the slight possibility that the count for that species should have been 41. No such possibility exists for *D. canariensis*, illustrated here (Fig. 10), for which the only possible alternative to n = 40 would have to be n = 39, which we reject. This species is now known to occur in Morocco (Romariz, 1953) and Iberia (Jalas & Suominen, 1972; see also Molesworth – Allen, 1977: 274).

Diplazium (Pl. VIII)

A clear root-tip count of 2n = 82 (Fig. 33) confirms that *Diplazium caudatum* is indeed correctly placed in this genus, and not in *Athyrium*. This species was recently discovered not to be endemic to Macaronesia, since it still persists in the southern extremity of Spain (Molesworth-Allen, 1971, 1977).

Dryopteris (Pls VIII and IX)

A review of this genus in Macaronesia, excluding the Cape Verde Islands, is provided by Gibby (1979, 1985*a*); see also Fraser-Jenkins (1981, 1982). In the list of cytologically worked taxa given below, the geographical occurrence of each is indicated by the initial letters a, c, m to indicate Azores, Canaries, or Madeira respectively.

	Diploids
acm	*D. affinis* subsp. *affinis* (Lowe) Fraser-Jenkins
m	*D. aitoniana* Pichi-Serm.
c	*D. oligodonta* Pichi-Serm.
acm	*D. aemula* (Aiton) Kuntze
a	*D. azorica* (Christ) Alston
m	*D. maderensis* Alston

	Tetraploids
c	*D. guanchica* Gibby & Jermy
a	*D. crispifolia* Rasbach et al.
a	*D. dilatata* (Hoffm.) Gray

The widespread apomictic species *D. affinis* (= *D. pseudomas* auct. = *D. borreri*) is represented in Madeira only by a diploid race (Figs 39a,b), although both diploids and triploids are widespread in Europe. As suggested by Gibby (1979: 350), the absence of the triploid cytotype from Madeira may be related to the fact that *D. oreades* Fomin (= *D. abbreviata* (DC.) Newman) is also absent.

D. aitoniana (= *D. macaronesica* Romariz) is a diploid (Fig. 37) sexual species with n = 41, endemic to Madeira. Its affinities are unclear since 'no close relatives are known' (Gibby 1979: 349). However, its gross morphology and phloroglucinol chemistry are closer to those of the *D. filix-mas* and *D. villarii* groups than to those of other members of the genus in Madeira (Widén et al., 1975; Euw et al., 1980, 1985). It is not present in the Canaries but is replaced by another distinct diploid species, *D. oligodonta*, also of uncertain affinity.

D. aemula (Figs 38a,b) and *D. maderensis* (Fig. 36), both also sexual diploids, are the only other members of the genus present in Madeira. A former record for *D. carthusiana* (Villars) H. P. Fuchs, attributed by Romariz (1953) to *D. austriaca* subsp. *spinulosa* auct. or by Hansen (though with some doubt) to *D. spinulosa* (Müller) Watt must be discounted as mistaken. Gibby & Walker (1977) have nevertheless shown that *D. maderensis* contains one of the ancestral genomes involved in the allotetraploid *D. dilatata* of Europe and that this same genome is shared both with *D. azorica* in the Azores and with *D. intermedia* (Muhlenb.) A. Gray of mainland N. America (see especially Gibby, 1979, 1983). This genome, when combined with that of *D. aemula*, has produced an allotetraploid, *D. guanchica*, now known from the Canaries and NW. Iberia but apparently not from Madeira in spite of the presence there of the two parental taxa. Yet another allotetraploid species, of the same genomic composition as *D. guanchica* but probably derived locally from *D. azorica* × *D. aemula*, is represented by an Azorean endemic, *D. crispifolia* Rasbach, Reichstein & Vida (see Gibby, 1985*a*; Gibby et al., 1977).

Elaphoglossum (Pl. X, Fig. 44)

This essentially tropical genus is absent from mainland Europe though included in *Flora Europaea* because of its presence in the Azores. The monoploid chromosome number in the genus is x = 41, as recorded unambiguously for more than one species in Sri Lanka (Manton & Sledge, 1954). Taxonomic and nomenclatural revision for representatives of the genus in the Indian peninsula and Sri Lanka were later carried out by Sledge (1967), who gave reasons for reviving the name *E. paleaceum* Hook. & Grev. for Macaronesian material instead of *E. hirtum* (Sw.) C. Chr. used by Romariz (1953) in the (mistaken) belief that these two names were synonyms. However, Benl in Mabberley (1980) has recently detected an older name (*Lomaria semicylindrica* T. Bowdich), which he has introduced into *Elaphoglossum* as a new combination applicable to this species. *E. semicylindricum* (T. Bowdich) Benl is therefore presumably now the valid name (see also Hansen & Sunding, 1985). The species is tetraploid (Fig. 44) with 2n = 164.

Hymenophyllum (Pls IV & V)

The two European species (see Evans, 1966), *H. tunbrigense* and *H. wilsonii* (= *unilaterale* auct. = *peltatum* auct., non. Desv.) possess different chromosome numbers (Manton, 1950), namely, n = 13 and n = 18 respectively. At the other side of the world, Brownlie (1958) showed that two species, *H. revolutum* Colenso and *H. peltatum* Desv., formerly confused with the European taxa but replacing these in New Zealand, are cytologically different, having n = 22 and n = 11 respectively. Elsewhere in the southern hemisphere, notably on Tristan da Cunha (Manton & Vida, 1968), the two European taxa with their distinctive chromosome numbers recur.

The same is true in Madeira, though the full facts are not easily ascertained. *H. tunbrigense* (Fig. 15a) gave no difficulty, being abundant in many suitable sites for which the expected chromosome number (n = 13) was clearly demonstrated, as in Fig. 15b. *H. wilsonii*, in contrast, is so rare that we failed to find it and, indeed, two entries in Hansen & Sunding (1979) claiming Porto Santo and Desertas as localities for this elusive species seem to us so improbable as to suggest typographical errors. We are in fact indebted to G. Benl for access to living material

(Fig. 16a) from Madeira (see Benl 1971: 170), and this eventually gave the expected chromosome count of n = 18 (Fig. 16b).

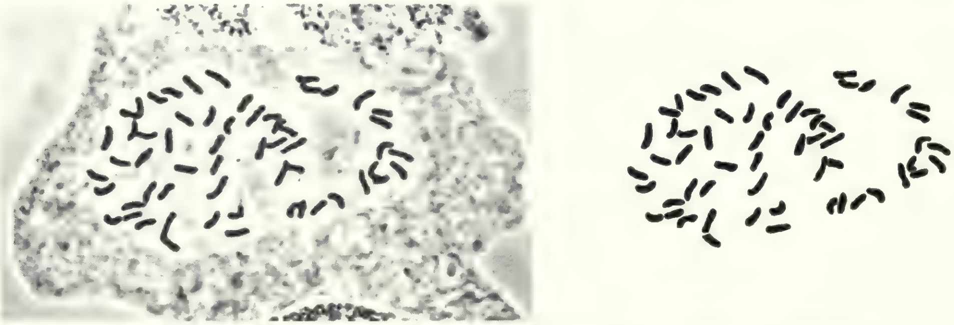
Authentication of the distinctive chromosome numbers of *H. tunbrigense* and *H. wilsonii* on Madeiran specimens (Figs 15b, 16b) has enabled us to resolve an unexpected situation that would have baffled us otherwise. In 1949 material with the morphology of *H. wilsonii*, collected at Queimadas, was found to have an irregular meiosis associated with bad spores and a pattern of chromosome pairing which at that time was inexplicable (see Fig. 18c). This plant died out but is still represented by a herbarium specimen at BM (Figs 18a, b) gathered by the late A. H. G. Alston when visiting Leeds. Later, in 1969, a morphologically similar individual (Figs 19 a,b) was collected from a different locality (Pico do Tapeiro above Encumeada) and a mitotic count of 2n = 49 was obtained from a young leaf by G. Vida (see Fig. 19c). Such a number seemed to correspond to that of a hybrid containing *two* genomes of *H. wilsonii* and only *one* genome of *H. tunbrigense* (i.e. 18 + 18 + 13), hence perhaps its considerable external resemblance to *H. wilsonii*.

A triploid hybrid of this composition can of course potentially arise in more than one way; for example, by means of multiple or unreduced gametes or as a cross involving an unknown polyploid ancestor. The field season of 1970 brought further insight into this particular problem. Firstly, it was found that the triploid hybrid occurred intermittently along more than 100 metres of the rock wall of Pico do Tapeiro, a fact which we still do not understand in view of the sterility of this plant. Secondly, an unsuccessful attempt to relocate the 1949 hybrid at Queimadas resulted instead in the discovery of a single population (Figs 17a,b) of the postulated amphidiploid between *H. tunbrigense* and *H. wilsonii*. This population, the only one of its kind at present known, has a chromosome number of n = 31 (Fig. 17c) with regular pairing. This plant is therefore fertile and must be recognised as an independent species. It must have arisen by chromosome doubling in an initial hybrid between *H. tunbrigense* and *H. wilsonii* which later back-crossed to *H. wilsonii*, giving rise to the triploids previously encountered.

This situation in Madeira is unique in the genus, since hybrids between *H. tunbrigense* and *H. wilsonii* are unknown elsewhere (cf. Richards & Evans, 1972). In New Zealand, equivalent hybrids reported by Cockayne & Allan (1934) are, of course, different since they involve only the vicariant taxa noted earlier. The newly detected amphidiploid in Madeira is morphologically distinguishable from both ancestral types by means of details of the indusial margin and of cell configuration in the leaf epidermis, illustrated from Tristan da Cunha by Manton & Vida (1968). The new amphidiploid is intermediate between the two parental types in both these characters and will be formally described later.

Notholaena (Pl. I) (See Pichi-Sermolli, R. E. G. 1985. *Webbia* **19**: 179–189.)

N. marantae is represented in Madeira by subsp. *subcordata*, a plant mainly, though not exclusively, Macaronesian in distribution. Madeiran material of it is diploid with n = *c.*29 (Fig. 1). This illustration can now be supplemented by a beautiful root-tip squash showing exactly 2n = 58, kindly supplied by Mrs H. Rasbach from a new gathering made in 1985. This photograph, with an explanatory drawing, is reproduced here in the text, having arrived too late for inclusion in Plate I. We are most grateful to Mrs Rasbach for her courtesy.



N. marantae, root tip squash, ×1000, showing 2n = 58 (courtesy H. Rasbach).

N. lanuginosa (*Cheilanthes catanensis*; *C. vellea*) is known to be cytologically complex. Our counts, from a single locality in Madeira, are tetraploid with n = 58 (Fig. 2), as already cited by Manton & Sledge (1954) under *C. vellea*. A diploid is, however, recorded from Spain, while tetraploids have been found in several parts of southern Europe (Vida et al., 1970) and both types occur in the Canaries.

Recently Badré & Reichstein (1983) have recognised the two cytotypes as subspecies, though the tetraploid (subsp. *lanuginosa*) corresponds best to the type of the species.

Oreopteris (Pl. III)

Our illustration of meiosis in *O. limbosperma* from Madeira clearly demonstrates n = 34 (Fig. 13), as in Britain, though an older name (*Thelypteris oreopteris* (Ehrh.) C. Chr.) was used by Manton (1950) and by Hansen & Sunding (1979). For further information see Holttum (1983).

Phyllitis (Pl. VII)

The so called hart's-tongue fern, *P. scolopendrium*, so common in Europe, is inexplicably rare in Madeira, especially in view of the relative abundance of some other taxa, such as *Asplenium onopteris* and *Trichomanes speciosum*, which elsewhere are far more dependent on oceanic and hydrophilous conditions. It was not found at all in 1949 (though looked for) and we have seen it since only once, in an inaccessible position above a waterfall at Rabaçal. We are therefore grateful to the late Major C. H. C. Pickering for supplying living material from Levada do Moiro from which the expected diploid chromosome count (n = 36) was eventually obtained (Fig. 30).

Polypodium (Pls XI, XII)

The circumboreal *P. vulgare* complex is represented in Europe by three different ploidy levels based on x = 37 and individually representing three well-known species (Manton, 1950; Shivas, 1961*a*; *b*): *P. australe* Fée* (= var. *serratum* Willd.) diploid, *P. vulgare* sens. strict. tetraploid, and *P. interjectum* hexaploid. The hexaploid has been shown experimentally to contain the genomes of the other two taxa, but the origin and genomic content of the tetraploid is more obscure, apparently involving diploids now scattered in different continents.

All three ploidy levels (Pl. XI) occur in Madeira. Examples are not evenly distributed, the tetraploids and hexaploids (Figs 48, 49) being confined to mountains, though diploids are widespread (Figs 47a,b). The taxonomic identity of the polyploids is not in doubt but that of the diploids is complicated by the recent re-description (as species) of two additional entities in the Macaronesian flora, namely *P. macaronesicum* A. Bobrov (1964) based on a type from Teneriffe (= *P. vulgare* var. *teneriffae* Milde) and *P. azoricum* (Carv. Vasc.) R. Fernandes (1968), based on *P. vulgare* var. *azoricum* Carv. Vasc. from the Azores. More recently, Ward (1970) casts doubt on the validity of a specific distinction between *P. macaronesicum* and *P. azoricum*, an opinion with which Nardi (1977) and presumably also Roberts (1980) are in accord. Still more recently, Garretas & Salvo-Tierra (1979) have recorded what they believe to be *P. macaronesicum* in southern Spain, together with a single sterile hybrid believed to combine this with *P. australe*, though both records are as yet unconfirmed cytologically and are not accepted by Fraser-Jenkins (1982).

An analytical key, drawing on microscopical characters for separating the two putative diploids (*P. australe* and *P. macaronesicum*) from each other and from the two polyploids (*P. vulgare* and *P. interjectum*) has recently been compiled by Roberts (1980) but, without this, gross external morphology has necessarily been the main basis for interpreting Madeiran diploids. Thus the small frond at top left on Pl. XII, initially interpreted as *P. australe*, is a voucher specimen from a pot plant carrying a label in I. Manton's handwriting stating that the roots had been fixed in the field (in 1949) and found to be diploid. In contrast, the two large fronds at right on Pl. XII were pressed in the field by Dr Sledge, also in 1949, but without cytological study by Manton, and these are labelled in Dr Sledge's handwriting with details of the date and place. These fronds can nevertheless now be recognised as so much larger than anything previously obtained from true *P. australe*, either in culture or wild in Britain, as to suggest a different taxon. Therefore, applying the Roberts (1980) key, we illustrate an empty sporangium from one of these actual fronds (Fig. 47c) and note that it displays exactly the right number of non-indurated cells between the base of the annulus and top of the stalk, interpreted by Roberts as diagnostic of *P. macaronesicum*. Similar specimens have subsequently been collected again and cytologically investigated several times, see especially Fig. 47b obtained in 1985 by M. Gibby from specimens collected by J. R. Press (= Chelsea reference no. CPG 6860); the diploid condition is thus beyond dispute. Both specimens on Pl. XII are nevertheless attributable to *P. macaronesicum*, according to R. H. Roberts whom we have consulted personally. However, further study of sporangial contents coupled with a cytological follow-up in any region (Europe or Macaronesia) in which both diploids might possibly occur together, is potentially important as the most likely means of detecting a hybrid, if it exists. This, more than any other single observation, could clarify the taxonomy definitively.

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* Fraser-Jenkins (1982) introduced *P. cambricum* L. to replace *P. australe*, presumably following the *International Code of Botanical Nomenclature* in which Art. 71, forbidding use of a name based on a monstrous specimen, was deleted by the Leningrad Congress, 1975. The relevant Linnaean specimen is teratological and without sori. We retain the name *P. australe* here in order to maintain continuity with preceding literature.

Polystichum (Pl. IX)

Only three species of *Polystichum* sensu stricto have been validly recorded from Madeira. Two of these (*P. drepanum* and *P. falcinellum*) are endemic, but the third (*P. setiferum*) is widespread in Europe. Another endemic taxon, formerly included under *Polystichum* or sometimes under an older name as *Aspidium webbianum* A. Braun, is treated here under *Arachniodes*. In contrast, we have disallowed as almost certainly an error the claim that *P. aculeatum* (L.) Roth is also present (Romariz, 1953; Hansen, 1969; Hansen & Sunding, 1985). An additional endemic taxon, *Polystichum maderense* Johnson, is listed (with minor misspelling) by Romariz (1953: 88) and by Hansen (1969), but correctly diagnosed as a hybrid by Hansen & Sunding (1985). This is dealt with below.

Cytologically, all three undoubtedly native Madeiran species are different, *P. setiferum* (Fig. 42) being diploid (n = 41) as elsewhere, *P. drepanum* (Fig. 40) tetraploid (n = 82), and *P. falcinellum* (Fig. 41) octoploid (n = 164). *P. drepanum*, though distinctive morphologically, is now very rare and our count is based on only a single specimen. *P. falcinellum*, on the other hand, though equally distinctive, is more common.

In addition to these taxa, a single plant, collected near Rabaçal, proved to be pentaploid with n = 205 (Fig. 43b). It was sterile with an external morphology appropriate to that of a cross between *P. falcinellum* and *P. setiferum*, a hybrid inferred to exist by Hansen & Sunding (1985). Chromosome pairing (Fig. 43a) was highly irregular, consisting mainly of univalents though with a variable and low number of bivalents. In the cell illustrated (Fig. 43a), the spindle lies across the page and the bivalents show the characteristic pulled-out appearance usual in species hybrids in this particular genus (Sleep, 1966; Sleep & Reichstein, 1967); the number of bivalents in this cell is not more than 24 and the range in other examples is from 18–32. This suggests that *P. setiferum* itself is unlikely to be ancestral to *P. falcinellum* since a minimum of 41 pairs would be expected if this were otherwise. The large number of univalents suggests further an allopolyploid constitution for *P. falcinellum*, though nothing is as yet known regarding any potential ancestors.

Our specimen of the pentaploid hybrid corresponds morphologically to a gathering from Pico Arieiro made by M. L. Nilsson in 1969 and illustrated by Hansen (1970: fig. 9). This in turn agrees closely with the description of *P. maderense* as given by Johnson (1866) on the basis of a single gathering from Rib. Janela. Hybridity as such was not mentioned by Johnson, though he explicitly noted the apparently intermediate morphology of his plant compared with both the taxa now accepted as parental. Further information will be given elsewhere.

Pteridium (Pl. II)

Until recently bracken, *Pteridium aquilinum*, with n = 52 (Fig. 6) in Britain, Sri Lanka, and elsewhere, was interpreted as a diploid from a lack of alternative evidence (see Manton, 1950, 1958). This has now been corrected by the discovery of bracken populations on limestone in Spain and Jugoslavia with half this chromosome number (Löve & Kjellquist, 1972). The base number of the genus must, therefore, be accepted as x = 26 and estimated ploidies (see also Page, 1976) adjusted accordingly.

Pteris (Pl. II)

The only genuinely native species of this genus (among several adventives) found in Madeira is listed as *P. arguta* by Romariz (1953), Hansen (1969), and Hansen & Sunding (1985), but as *P. serrulata* Forssk. by Jalas & Suominen (1972: 56). However, Morton (1969) had given reasons for preferring the name *P. palustris* for this taxon, though this recommendation seems to have been overlooked. This species (Fig. 7), found by us to be diploid (n = 29) in Madeira, has recently been discovered in the southern tip of Spain (Molesworth-Allen, 1971, 1977), a region harbouring so many Macaronesian taxa.

Stegnogramma (Pl. III)

Our count (Fig. 14) for *S. pozoi* in Madeira (n = 72, interpreted as tetraploid) was first reported in Manton & Sledge (1954: 138) under the name *Leptogramma africana*. Other names applicable to the same species (see Manton, 1959) have included *Thelypteris pozoi* (Lagasca) C. Morton in Hansen (1969) and Hansen & Sunding (1985) or *Lastrea africana* (Desv.) Copel. in Romariz (1953). For a review of the nomenclature see Holttum (1983).

Trichomanes (Pl. III)

The Killarney fern, *T. speciosum* occurs in Europe and Macaronesia. The chromosome number (Fig. 11) n = 72 is exactly the same in Madeira as in Britain, though the estimated ploidy may perhaps need qualification. It is tetraploid relative to some tropical species (see Manton & Sledge, 1954) with n = 36, but even these may perhaps be polyploid relative to the much lower numbers present in other members of the Hymenophyllaceae (see under *Hymenophyllum* above).

Woodwardia (Pl. X)

The chromosome number of *W. radicans* in Madeira was correctly recorded as n = 34 by Manton & Sledge (1954: 138). This number is confirmed in Fig. 46b on a Kew plant from the Azores, and we can now extend the evidence by means of a mitotic count of 2n = 68 provided by J. D. Lovis in 1970 from Madeira. For further information on the geographical interest of this taxon see the discussion below.

Discussion and conclusions

There are many summaries of chromosome numbers in ferns, sometimes associated with discussions on the possible evolutionary or ecological significance of polyploidy within the group (e.g. Manton, 1953, 1969; Klekowski & Baker, 1966; Löve et al. 1977; Lovis, 1977). The more recent additions to the known flora of Madeira have slightly changed the overall statistics, while greatly adding to their interest. For one thing, the cytological information summarized in two different ways in Tables 1 and 2 is now much more complete than formerly; future changes on a comparable scale are therefore unlikely to be required. It is true that verification from the island itself is still needed for three species introduced into the list on the basis of morphology amplified by tetraploid counts in adjacent areas. These are *Asplenium septentrionale*, *Cheilanthes guanchica*, and *C. tinaei*, as discussed on pp. 133 & 135 above. Reasons have also been given for the expectation that two additional species (*Ceterach officinarum* and *Asplenium adiantum-nigrum*) may still await local discovery. Nevertheless, even without these, our present total of more than 95% of the indigenous fern flora is authoritative to a degree not achieved previously.

Changes of more than one kind have nevertheless occurred between the two dates summarized in Table 2. On the one hand, new information from outside the region has changed the basis of assessment of ploidy in at least one case. *Pteridium aquilinum*, with n = 52, is now listed as a tetraploid in Table 1, though in 1950 it was necessarily included among the diploids.

Explicit mention was not made by Manton (1950) regarding endemic taxa as distinct from other members of the Madeiran flora, though this omission can now be made good by means of the asterisks in Table 1. There are eight taxa marked in this way, collectively representing about 15% of the total flora. Another omission from the summary of 1950 was any reference to apomictic taxa. There are in fact two such taxa, notably *Asplenium monanthes* (triploid) and *Dryopteris affinis* (diploid), a number unlikely to increase with further sampling. Collectively these represent some 4% of the named taxa. The incidence of hybridity, unassociated with either agamospory or amphidiploidy, is less certain. Two sterile species-hybrids (not included in

Table 1 List of taxa and grades of ploidy, excluding sterile hybrids.

2×
Adiantum capillus-veneris
Anogramma leptophylla
**Arachniodes webbianum*
Asplenium anceps
A. hemionitis
A. marinum
A. onopteris
Athyrium filix-femina
Blechnum spicant
Cheilanthes maderensis
Davallia canariensis
Diplazium caudatum
Dryopteris aemula
D. affinis
**D. aitoniana*
**D. maderensis*
Hymenophyllum tunbrigense
H. wilsonii
Notholaena marantae subsp. *subcordata*
Oreopteris limbosperma
Phyllitis scolopendrium
Polypodium macaronesicum
Polystichum setiferum
Pteris palustris
Woodwardia radicans
3×
Asplenium monanthes

4×
Asplenium billotii
[*A. septentrionale*]
A. trichomanes subsp. *quadrivalens*
[*Cheilanthes guanchica*]
[*C. tinaei*]
Christella dentata
Culcita macrocarpa
Elaphoglossum semicylindricum
**Hymenophyllum* sp.
Notholaena lanuginosa subsp. *lanuginosa*
Polypodium vulgare
**Polystichum drepanum*
Pteridium aquilinum
Stegnogramma pozoi
Trichomanes speciosum
6×
**Asplenium* sp.
**Ceterach* sp.
Cystopteris fragilis
Polypodium interjectum
8×
**Polystichum falcinellum*
10×
Adiantum reniforme
12×
Asplenium aethiopicum

* endemic.
[] counted only from other areas.

Table 2 Comparative statistics for the cytology of the fern flora of Madeira available at two dates, namely Manton (1950) and the present communication.

	Taxa used	Fraction of flora	Total diploids	Total polyploids	Percent diploids	Percent polyploids
1950	38	91%	22	16	58%	42%
1985	48*	95%	25	20 + 3	52%	48%

* inclusive of three taxa estimated but not counted.

either table) have been encountered and analysed in detail. These are respectively in *Hymenophyllum* and *Polystichum* and they are each unique of their kind. Other less extreme hybrids are likely to be present, though as yet unobserved.

These additions do not affect the generalization that the most conspicuous difference in the figures for the two dates listed in Table 2 concern the estimates of percentage frequency of polyploid taxa: 42% in 1950 and 48% in 1985. However, even this change is less disturbing than might have been expected, since comparable changes have concurrently been introduced elsewhere for similar reasons. Thus the island of Trinidad, formerly listed as similar to Madeira with 43% polyploidy (Walker, 1979: 102) has had this figure emended to 50% or a little less on the evidence summarized by Walker (1985). The similarity claimed for these two islands (Madeira and Trinidad) thus still remains valid. So also are the contrasts with other geographical regions, in which some, notably Sri Lanka, Jamaica, west tropical Africa, and Tristan da Cunha (as summarized in Manton & Vida, 1968; Manton, 1969) have no less than 60% polyploidy on information based on more than 100 taxa in several such regions. Extreme contrasts the other way, with 30% or less, include Malaya, the Himalayas, and the Canaries, though documentation of the latter is still incomplete. Unfortunately, there is as yet no generally agreed explanation of these resemblances and differences, though some early interpretations in terms of latitude or climate have been largely discounted.

Greater significance seems necessarily to be attributable to the grades of polyploidy attained within any flora. Here the contrasts between different geographical regions are considerably more marked, as noted by many authors (for literature see Walker, 1979, 1985). In Europe, even when amplified by many new findings from the unglaciated south, no grades higher than hexaploid or octoploid (see *Polypodium* and *Cystopteris*) have been encountered, although almost all the known indigenous ferns have now been studied cytologically. In Madeira, in contrast (Table 1), a much smaller flora contains an octoploid species in *Polystichum falcinellum*, together with a decaploid cytotype of *Adiantum reniforme* and a 12-ploid cytotype of *Asplenium aethiopicum*. These three taxa are undoubtedly African in origin and comparably high grades, including 12-ploid and even 16-ploid have been recorded for other taxa in Jamaica, west tropical Africa, Sri Lanka, and Tristan da Cunha (see Walker, 1979).

These facts must be borne in mind in any attempt to interpret the Madeiran flora as a whole, and so also must the local geological history within Macaronesia. The dramatic changes associated with the slow opening out of the Atlantic Ocean in Tertiary times have affected the main archipelagos differently. Thus the easternmost islands of the Canaries (Lanzarote and Fuerteventura) are still attached to the continental shelf, thereby emphasizing the intimate connection of this archipelago with Africa. At the other extreme, the Azores betray a former continental connection only by the presence of sedimentary rocks of Tertiary or late Cretaceous age, thereby suggesting that this archipelago may represent a rafted fragment that has become increasingly distant from its source, as in the cognate cases of Fiji and Kerguelen elsewhere. Madeira, on the other hand, being wholly volcanic in origin, possesses no sedimentary rocks, the oldest igneous rocks present being probably of Eocene date, and there is, therefore, no evidence of direct geographical displacement. Nevertheless the distances between the main archipelagos must formerly have been less than at present. This fact can scarcely be other than directly relevant to the past history of the local floras, all of which still include the main trees of the laurel forest which possess large seeds unsuited to long sea transit. Unfortunately there is no knowledge concerning how or when any of these trees first arrived on any of these islands.

Other aspects of this general problem are revealed by the increasing number of genuinely Macaronesian taxa which have recently been found to be present also in southern Europe, sometimes extending to N. Africa. Some examples have been noted under *Asplenium, Cheilanthes, Notholaena, Pteris, Dryopteris, Polypodium,* etc. Thus *Davallia canariensis* and *Woodwardia radicans* occur on the Asturias coast, *Culcita macrocarpa* and *Dryopteris guanchica* in Galicia and *Asplenium hemionitis, D. guanchica, Davallia*, and *Woodwardia* about Sintra near Lisboa (Jalas & Suominen, 1972; Gibby, 1979). Most unexpectedly, Molesworth-Allen (1971, 1977) has detected near Algeciras not only *Christella dentata*, a species previously thought to be subtropical or even tropical (though present in Sicilia and Kriti), but also several other unexpected taxa, notably *Culcita macrocarpa, Davallia canariensis, Pteris palustris,* and *Diplazium caudatum*. This last species in particular had previously been interpreted as a Macaronesian endemic.

Supplementary evidence of a different kind has been the discovery of some characteristic Madeiran ferns, notably *Woodwardia*, among the identifiable macrofossils from France (Saporta, 1865), disregarding the still problematical claim for *Adiantum reniforme*, as discussed under the genus. At the least, this all adds up to substantially increased positive evidence for an intimate relation between the fern flora of Macaronesia and surviving elements in the lusitanian flora of Europe.

While more detailed comparisons between the various archipelagos are at present inhibited by the absence of adequate documentation, more especially for the Canaries, it is sufficiently clear that there is no compelling reason for singling out (as in *Flora Europaea*) the Azores, alone among the Macaronesian islands, as a special representative of non-continental Europe. Further, the combined evidence from floristics, cytology, geographical distribution, and fossils now permits a substantially more interesting general conclusion to be reached. Verification is in fact provided, in no uncertain terms, for the essential validity of a concept first formulated by Engler (1879) and discussed recently by Sunding (1979). This is that the laurisilva as a whole, still represented in all the archipelagos (except the Cape Verdes), is a living fragment of a very similar, humid, subtropical, predominantly lauraceous forest, formerly widespread in southern Europe in Miocene and Pliocene times. Though the forest itself has died out in mainland Europe, we can now detect, among ferns, elements from the ground flora which have not died out. The advent of some African taxa into one or other of the Macaronesian islands, notably the high polyploids within *Polystichum, Asplenium,* and *Adiantum* on Madeira, while providing problems of their own, do not disturb the main conclusions. These are that the flora of Macaronesia in general, and of Madeira in particular, has contributed, and will contribute further as knowledge increases, to a better understanding than hitherto of the past history of Europe and especially of the extant lusitanian elements in its flora.

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Descriptions of plates

All photographs from permanent aceto-carmine preparations were made and photographed by the senior author except where otherwise stated. Magnifications × 1000 with a few annotated exceptions. Arrangements of taxa according to the system used by Hansen (1969), as far as space permits. For other information see alphabetical list of taxa.

Plate I
Figs 1–5 Sinopteridaceae and Adiantaceae. **1** *Notholaena marantae,* anaphase 1 showing n = *c*.29 (prep. J. D. Lovis); for mitosis see text. **2** *Notholaena lanuginosa*, meiosis with n = 58. **3** *Cheilanthes maderensis*, early diakinesis with n = *c*.30. **4a–b** *Adiantum capillus-veneris,* meiosis with n = 30 and mitosis with 2n = 60 (the latter an aceto-orcein prep. by J. D. Lovis). **5a–b** *Adiantum reniforme*, (preparations by J. D. Lovis), meiosis with n = 150 and mitosis with n = 300 (aceto-orcein).

Plate II
Figs 6–9 Pteridaceae, Hemionitidaceae, Dicksoniaceae, and Hypolepidaceae. **6** *Pteridium aquilinum* showing n = 52. **7** *Pteris palustris*, diakinesis with n = 29. **8a–c** *Anogramma leptophylla,* meiosis, three focal levels through one cell with n = *c*.27 (±1). **9a–c** *Culcita macrocarpa* from two plants at Kew; **a** and **b** meiosis with n = 68 analysed by G. Vida on a plant initially from Madeira and **c** mitosis with 2n = 136 from a root of a plant initially from the Azores (M. Gibby prep.).

Plate III
Figs 10–14 Davalliaceae, Hymenophyllaceae (in part), and Thelypteridaceae. **10** *Davallia canariensis,* meiosis with n = 40. **11** *Trichomanes speciosum*, meiosis with n = 72 (J. D. Lovis prep.). **12** *Christella dentata,* meiosis with n = 72. **13** *Oreopteris limbosperma,* meiosis with n = 34 (J. D. Lovis prep.). **14** *Stegnogramma pozoi,* meiosis with n = 72, illustrated in Manton & Sledge (1954) as '*Leptochilus africanus*'.

Plate IV
Figs 15–17 *Hymenophyllum* spp. **15a–b** *H. tunbrigense* **a** living leaf ×1.5 with a single sorus (inset) ×4; **b** meiosis in a specimen from another locality (V on map) with n = 13. **16a–b** *H. wilsonii,* **a** living leaf ×1.3

with a single sorus (inset) ×4; **b** meiosis with n = 18 (coll. Benl; prep. J. D. Lovis). **17a–c** *H. sp.* (amphidiploid); **a** living leaf ×1.3 with **b** sori, ×4 and **c** meiosis with n = 31 (J. D. Lovis prep.).

Plate V
Figs 18–19 *Hymenophyllum* hybrid, *H. sp.* × *wilsonii.* **18a–c** the first specimen found (1949); **a** frond soaked out from a herbarium specimen (BM) × 1.3 with **b** sori on the same ×4; **c** meiosis with pairs, univalents and perhaps a few multivalents. **19a–c** the second specimen (coll. J. D. Lovis, 1969) **a** living leaf in cultivation (1974) ×1.3 with **b** sori ×4 and **c** root tip squash (G. Vida) with 2n = 49.

Plate VI
Figs 20–28 *Asplenium* spp. **20a–b** *A. monanthes* (apogamous triploid); **a** meiosis in a '16 celled sporangium' showing pairs and univalents (J. D. Lovis prep.) and **b** meiosis in an 'eight celled sporangium' with 108 bivalents. **21** *A. trichomanes* subsp. *quadrivalens*, meiosis with n = 72 (prep. J. D. Lovis). **22** *A. anceps* (diploid) (coll. & prep. J. D. Lovis), meiosis with n = 36. **23** *A.* sp. (hexaploid) (coll. & prep. J. D. Lovis), meiosis with n = 108. **24** *A. billotii* (coll. & prep. J. D. Lovis), meiosis with n = 72. **25** *A. septentrionale* from Canaries (coll. Benl = TR 2536), mitosis (J. D. Lovis prep. in aceto-orcein) with 2n = 144. **26** *A. onopteris* (prep. J. D. Lovis), meiosis with n = 36. **27** *A. marinum*, meiosis with n = *c*.36. **28** *A. hemionitis* (prep. J. D. Lovis), meiosis with n = 36.

Plate VII
Figs 29–31 *Asplenium* (continued), *Phyllitis, Ceterach* (all preparations by J. D. Lovis). **29** *A. aethiopicum,* meiosis with n = 216. **30** *Phyllitis scolopendrium* (coll. Pickering, cult. Kew), meiosis with n = 36. **31** *Ceterach* sp. (hexaploid), meiosis with n = 108.

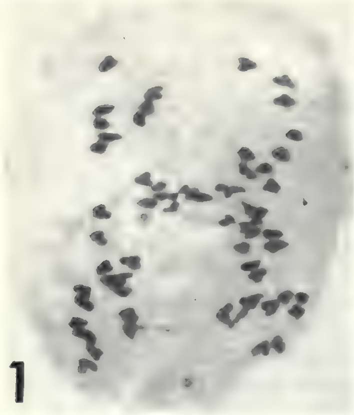
Plate VIII
Figs 32–38 Athyriaceae to Aspidiaceae. **32** *Cystopteris fragilis* subsp. *diaphana* meiosis with n = 126 (hexaploid). **33** *Diplazium caudatum* (coll. J. D. Lovis, root-tip squash G. Vida), mitosis with 2n = 82. **34a–b** *Arachniodes webbianum*; **a** meiosis (Kew plant) with n = 41 and **b** mitosis from a wild gathering (coll. J. D. Lovis, root-tip squash G. Vida) with 2n = 82. **35** *Athyrium filix-femina,* meiosis with n = 40. **36** *Dryopteris maderensis* (coll. and prep. by J. D. Lovis) meiosis with n = 41. **37** *Dryopteris aitoniana,* meiosis with n = 41. **38a–b** *Dryopteris aemula*; **a** meiosis with n = 41 and **b** mitosis from another locality (coll. and aceto-orcein prep. J. D. Lovis) with 2n = 82.

Plate IX
Figs 39–43 *Dryopteris* (continued) and *Polystichum.* **39a–b** *Dryopteris affinis* (diploid apomict); **a** meiosis in an '8 celled sporangium' with 82 bivalents and **b** mitosis in a root (G. Vida prep.) with 2n = 82. **40** *Polystichum drepanum,* meiosis with n = 82 (J. D. Lovis prep.). **41** *Polystichum falcinellum* (octoploid), meiosis with n = 164. **42** *P. setiferum* (diploid), meiosis with n = 41. **43a–b** Pentaploid hybrid (*P. falcinellum* × *P. setiferum*) (coll. and prep. J. D. Lovis) **a** meiosis showing irregular pairing, ×750 and **b** mitosis with 2n = 205, ×750.

Plate X
Figs 44–46 Elaphoglossaceae and Blechnaceae. **44** *Elaphoglossum semicylindricum* (coll. J. D. Lovis), mitosis (G. Vida prep.) with 2n = 164. **45** *Blechnum spicant* (coll. J. D. Lovis, prep. G. Vida), meiosis with n = 34. **46a–b** *Woodwardia radicans*; **a** mitosis (G. Vida prep.) with 2n = 68 and **b** supplementary fixing on a specimen from Azores at Kew, meiosis with n = 34.

Plate XI
Figs 47–49 *Polypodium* spp. **47a–c** *P. macaronesicum* (diploid); **a** meiosis with n = 37; **b** mitosis (M. Gibby prep.) with 2n = 74 and **c** authenticating sporangium from the large specimen at right on Pl. XII, × 140. **48** *P. vulgare* (tetraploid), meiosis with n = 74. **49** *P. interjectum* (hexaploid), meiosis with n = 111.

Plate XII
Polypodium macaronesicum (diploid). Herbarium specimens showing range in size, all initially diagnosed as *P. australe*, but recently authenticated by R. H. Roberts as *P. macaronesicum*. The top left-hand specimen grown in Leeds after initial fixation in the field; the two large specimens of wild fronds collected by W. A. Sledge in 1949 and the source of the sporangium illustrated in Fig. 47c.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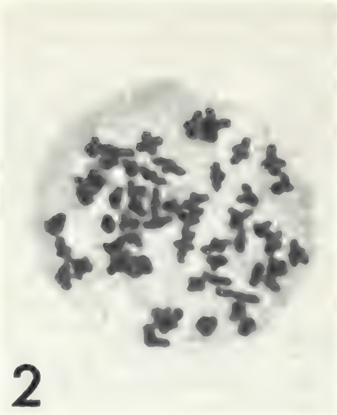
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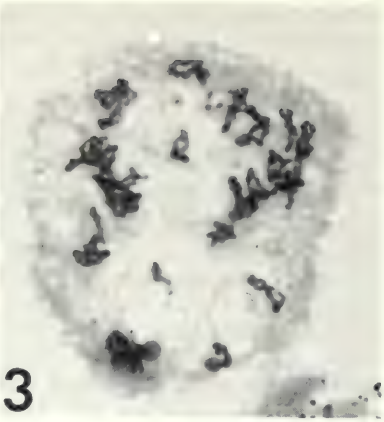
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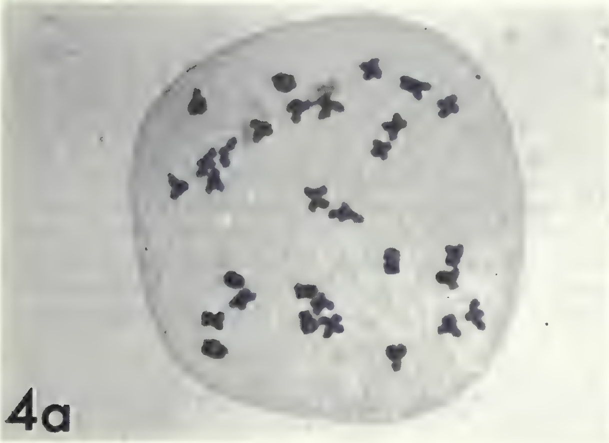
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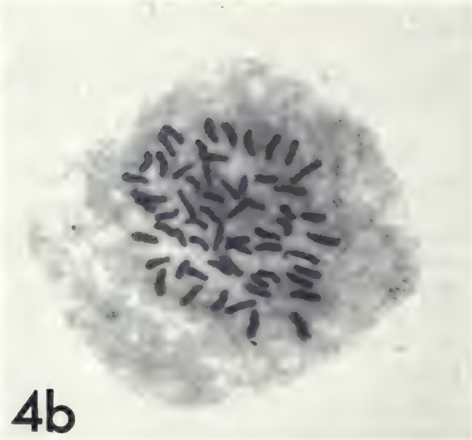
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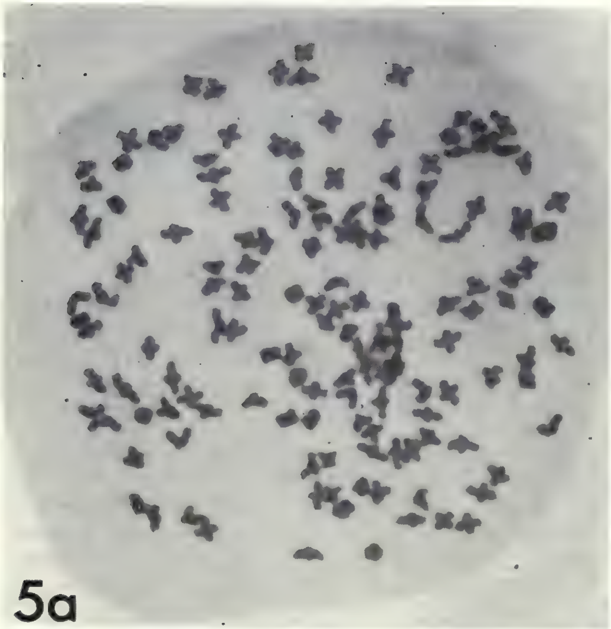
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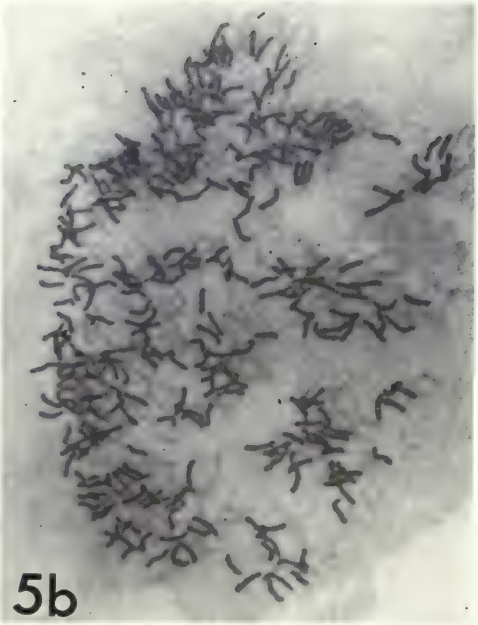
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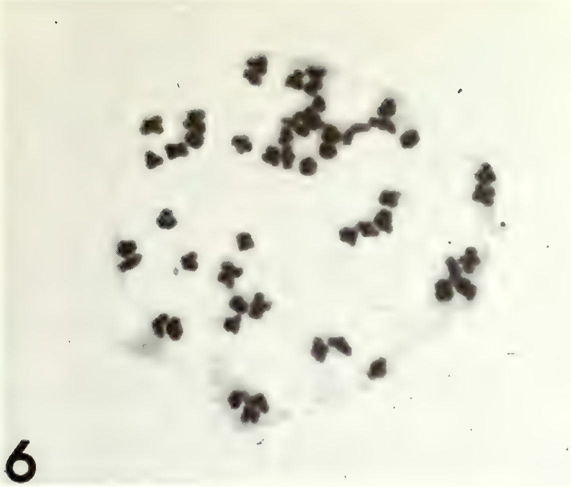
Plate I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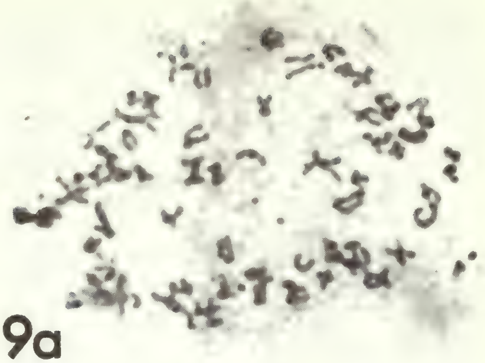
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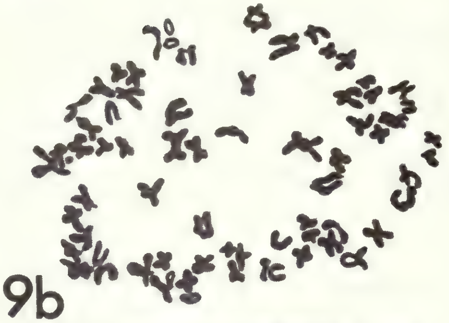
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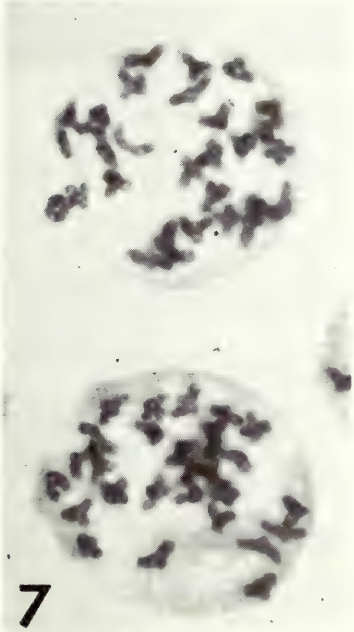
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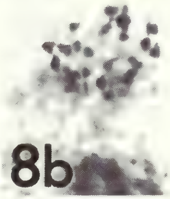
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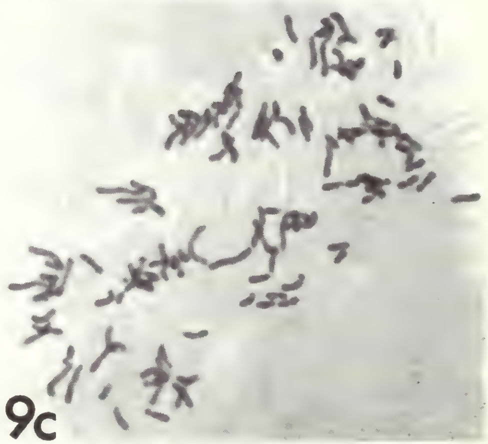
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Plate II

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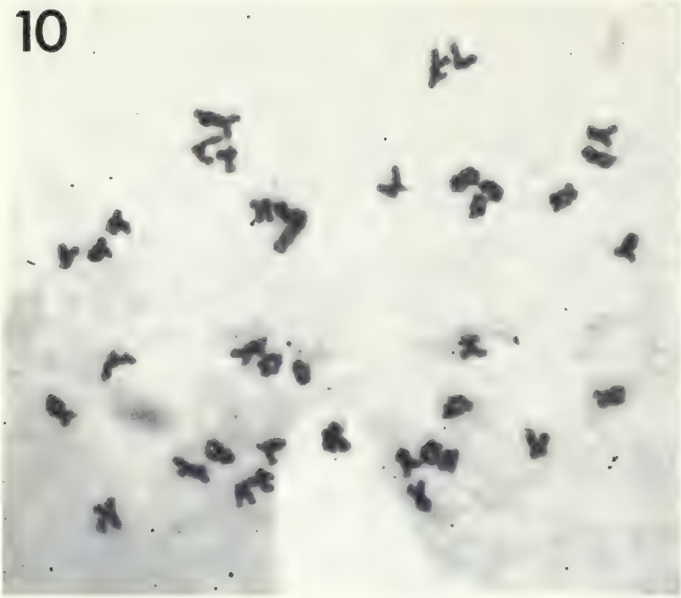

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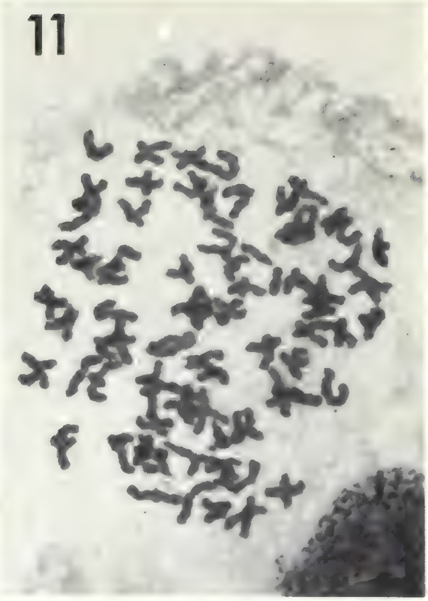

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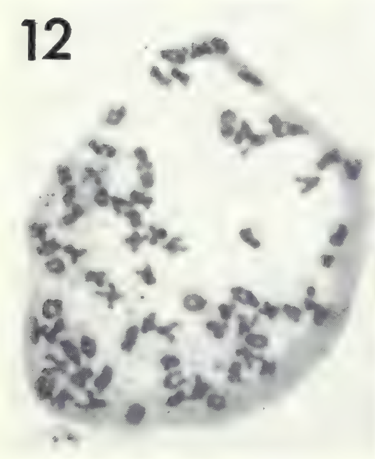

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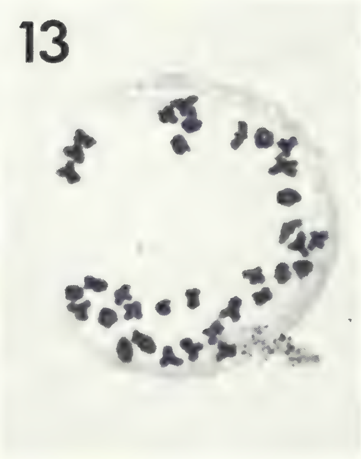

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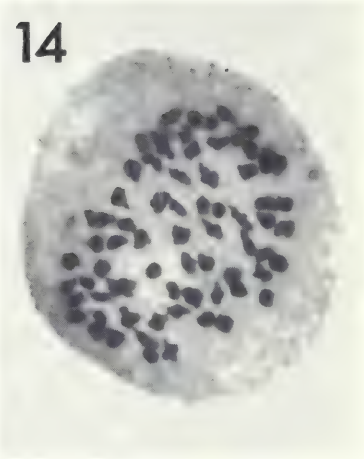

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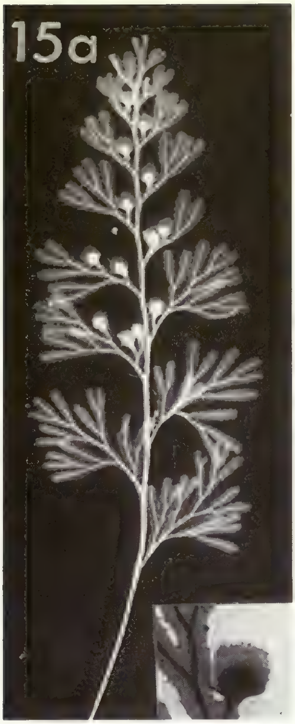

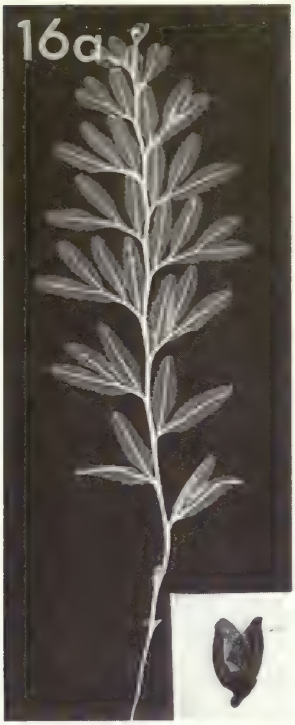

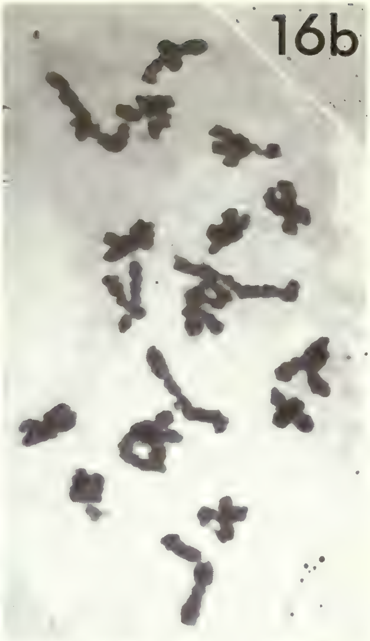

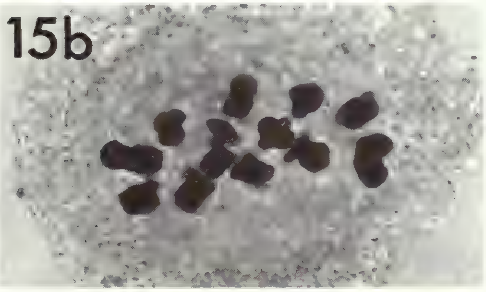

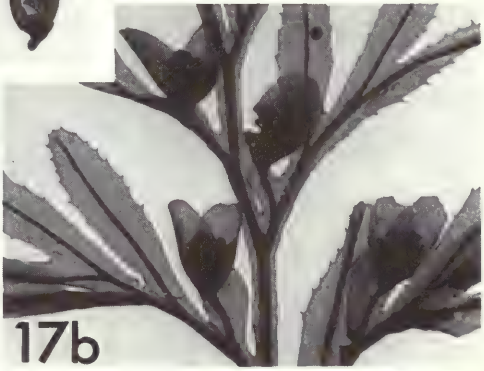

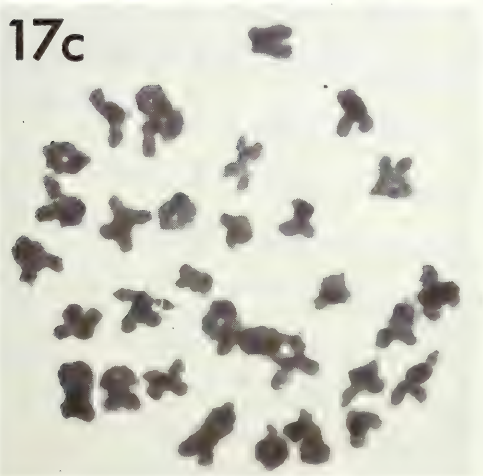

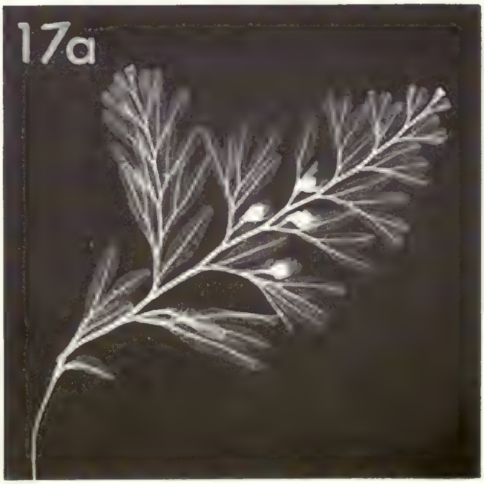

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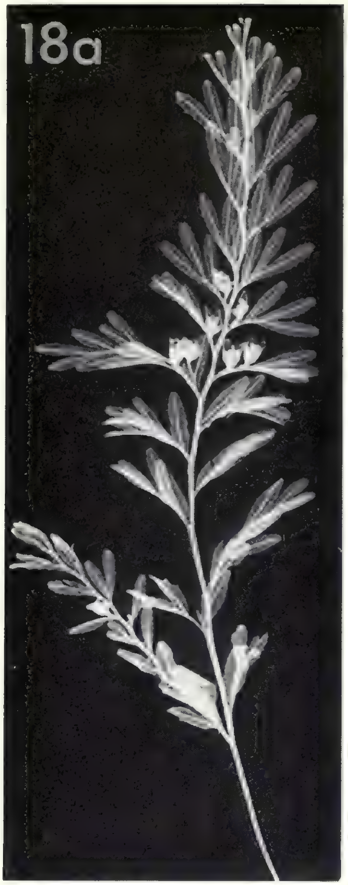
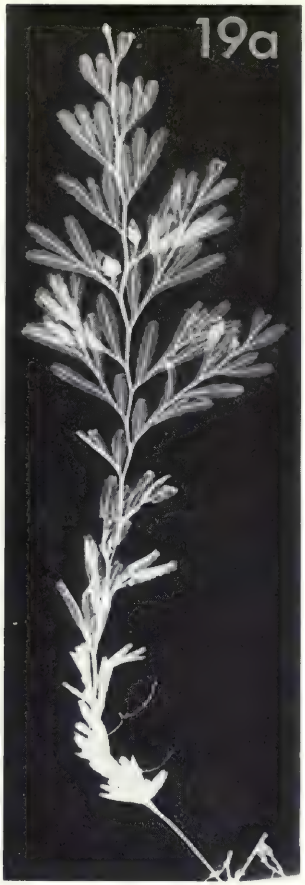
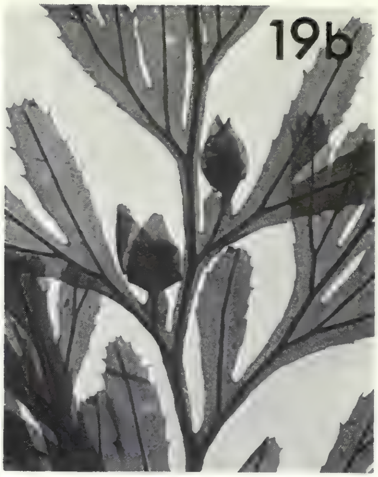
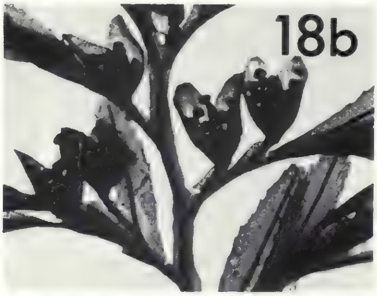
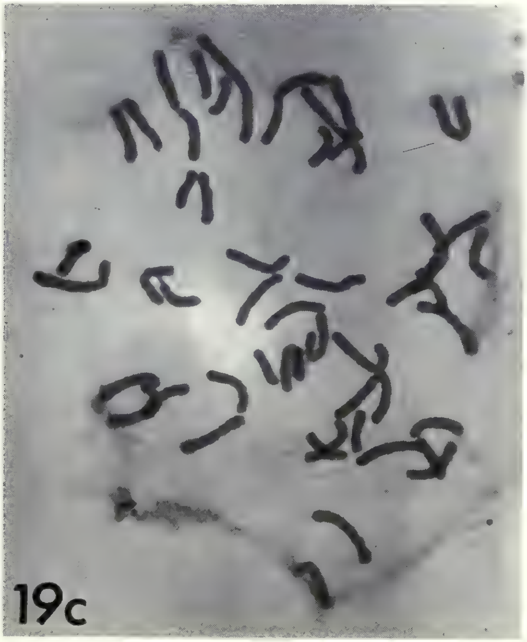










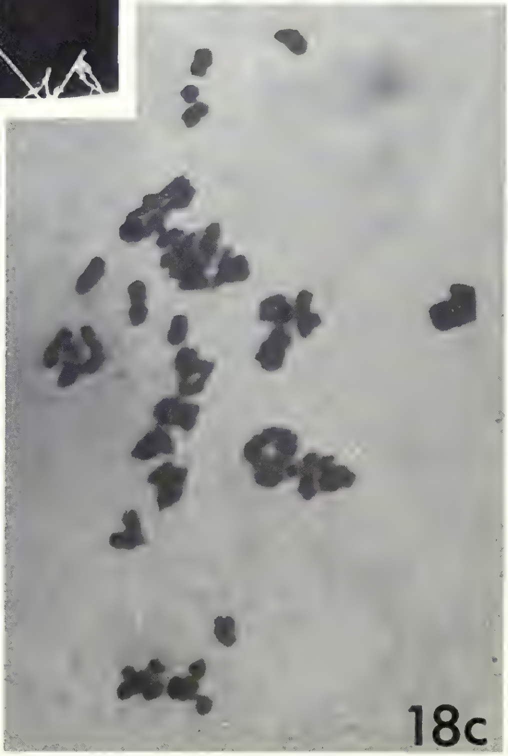
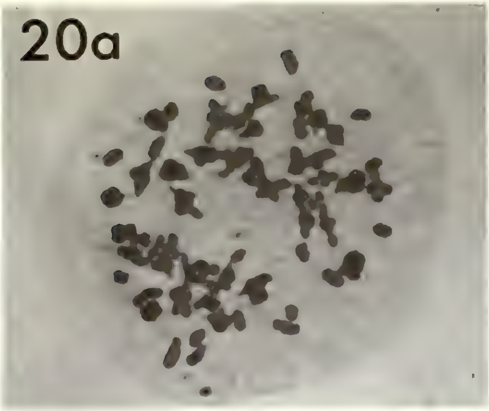


Plate V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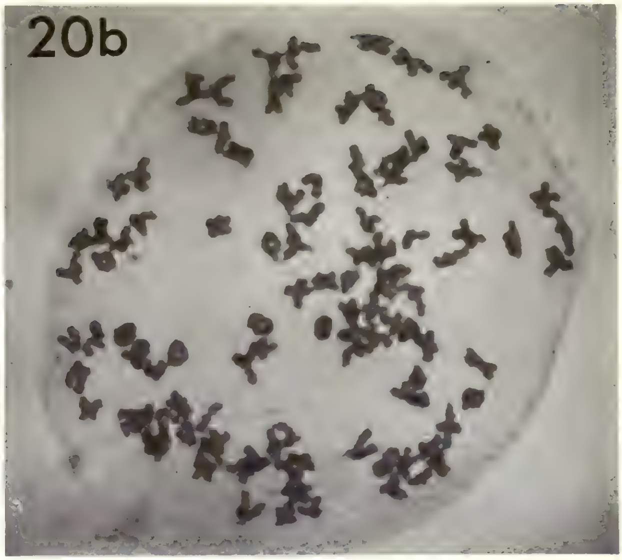
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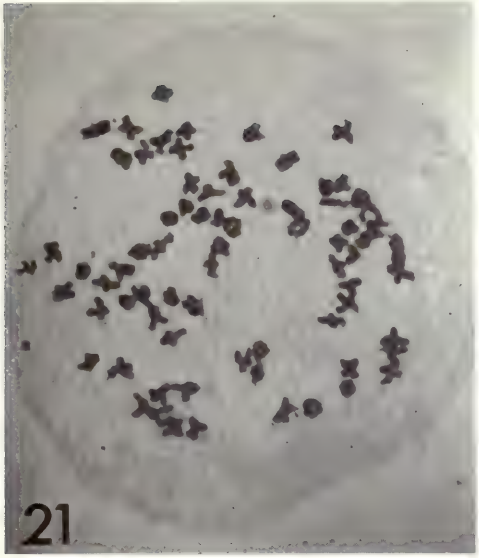
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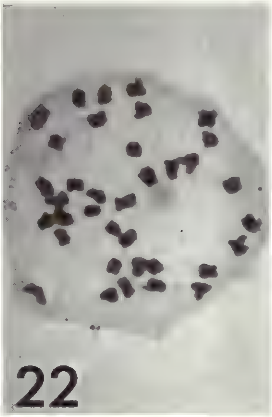
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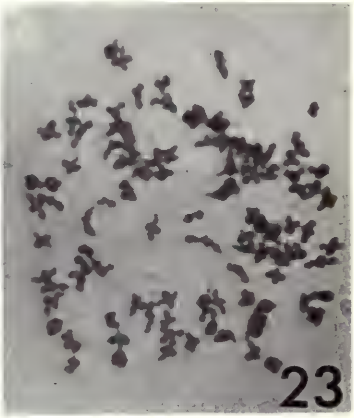
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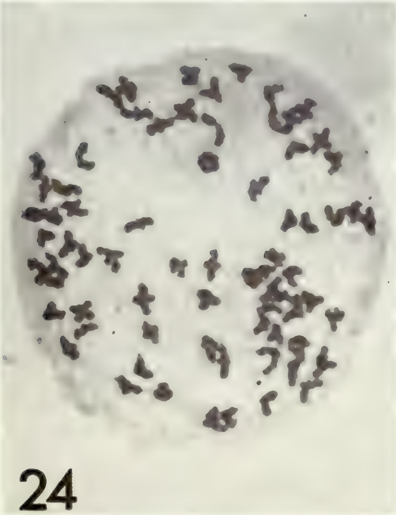
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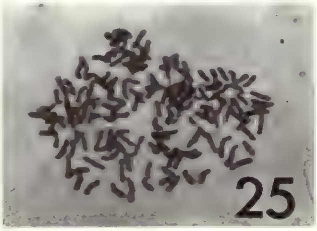
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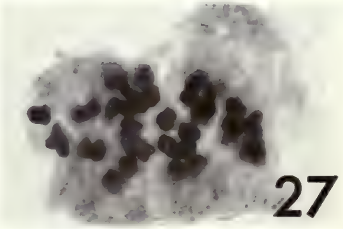
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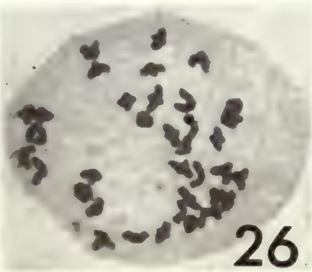
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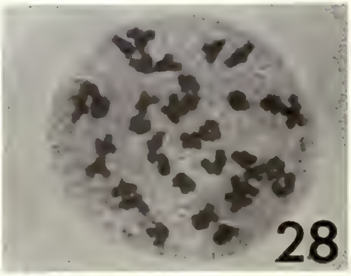
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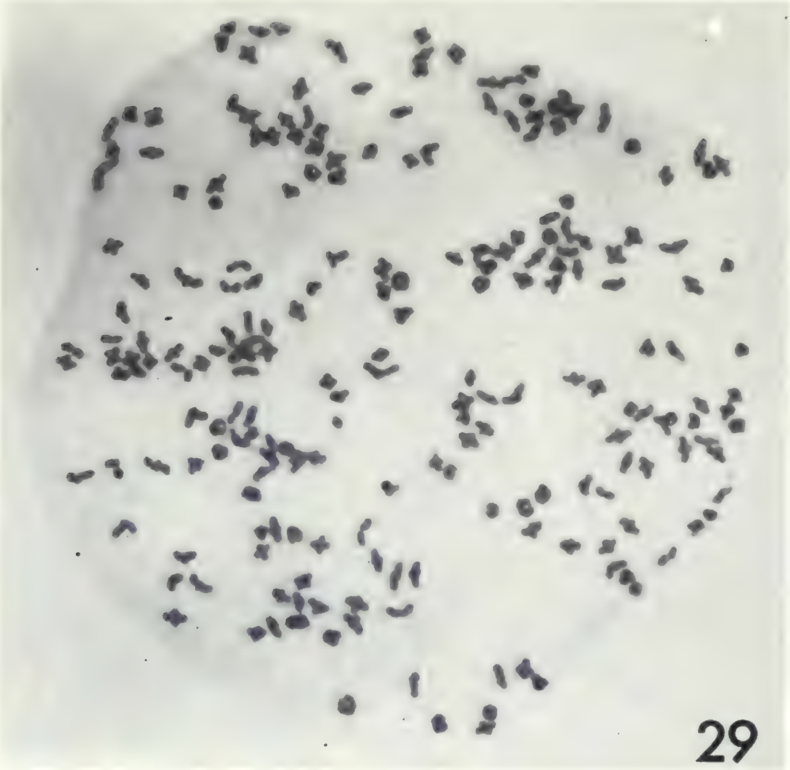
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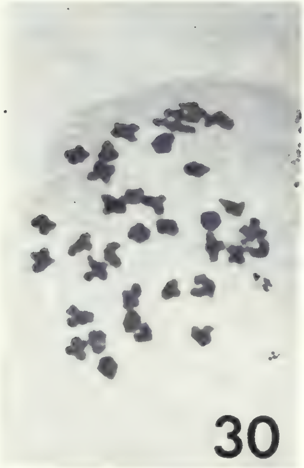
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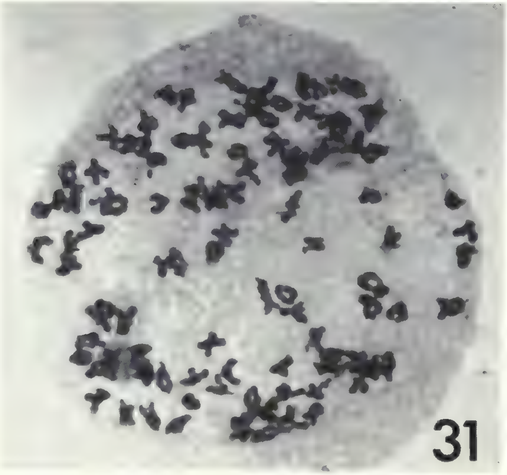
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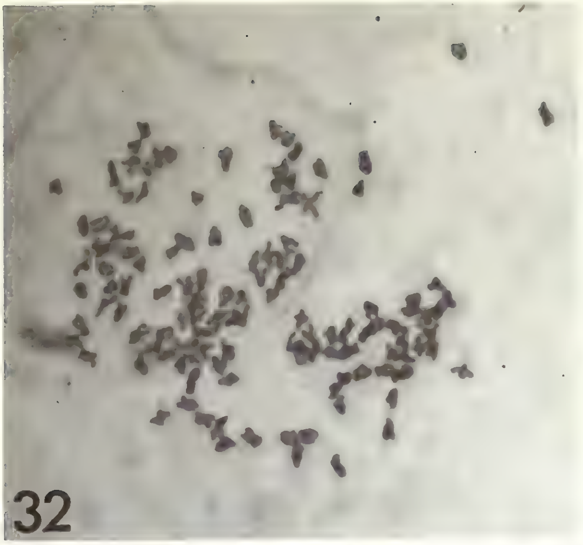
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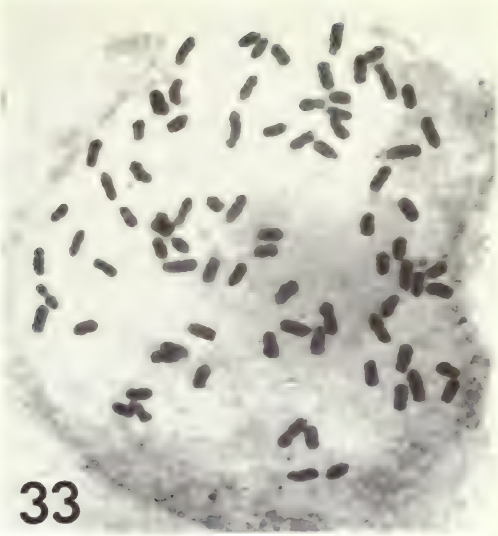
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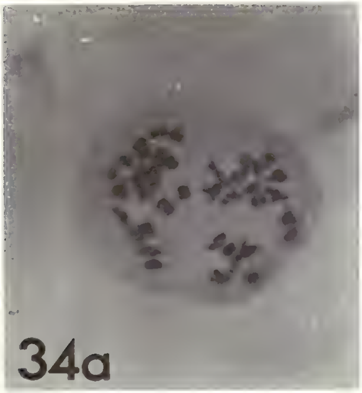
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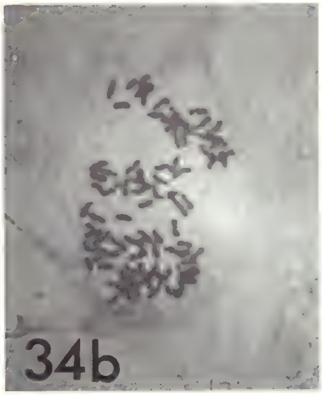
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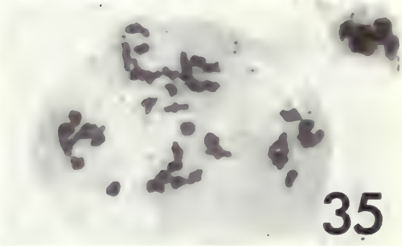
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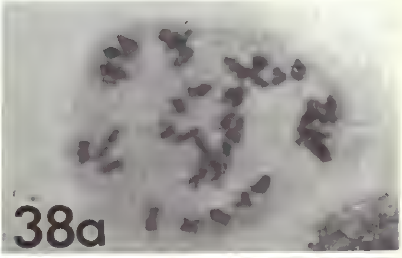
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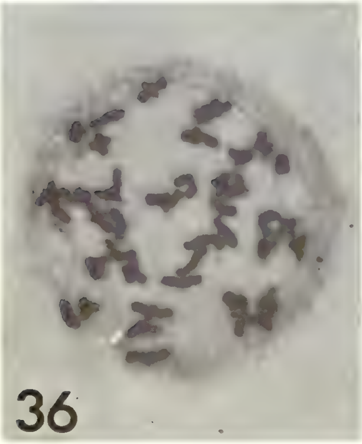
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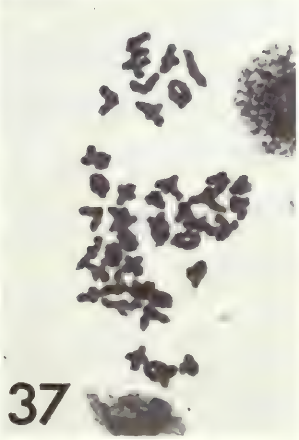
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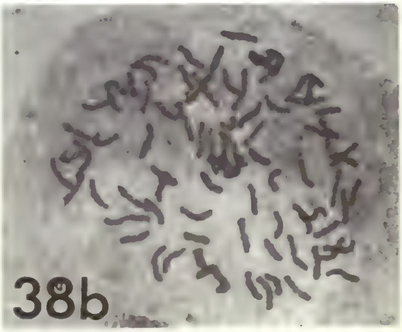
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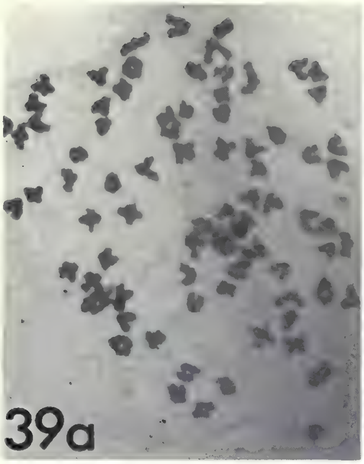
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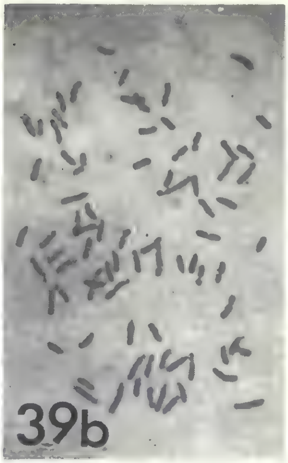
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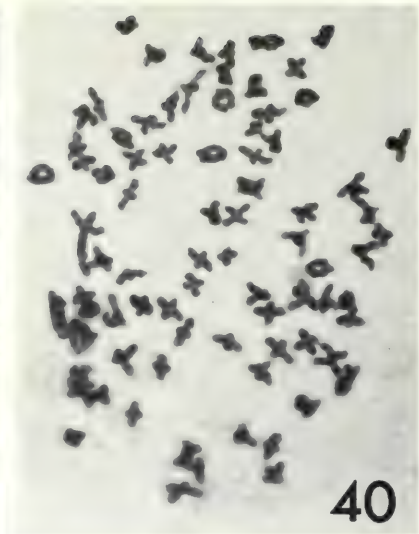
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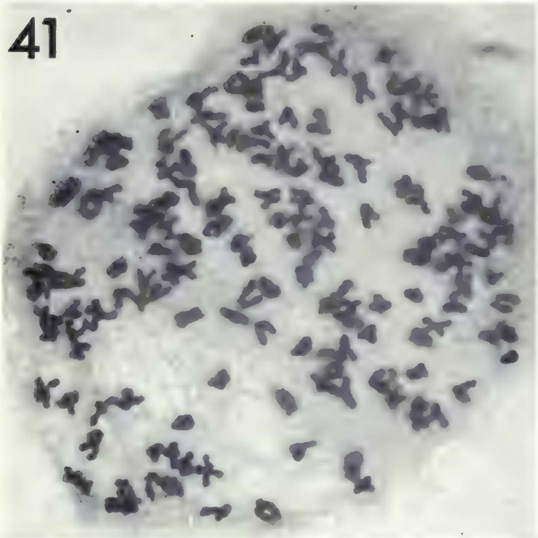
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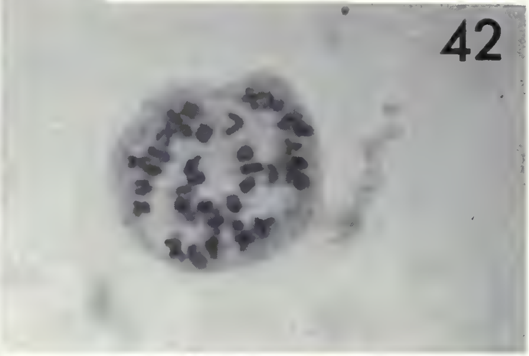
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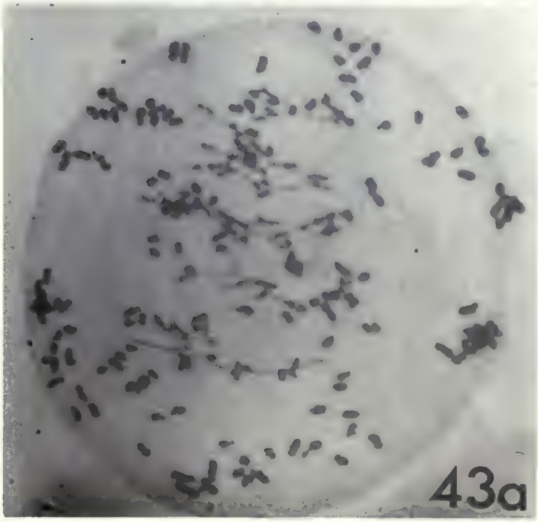
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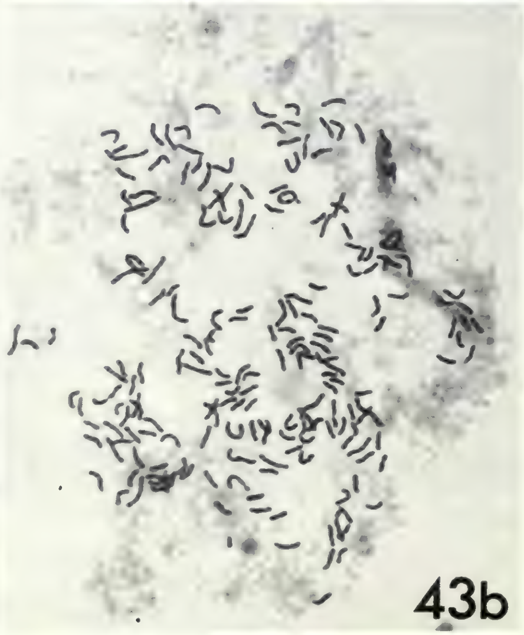
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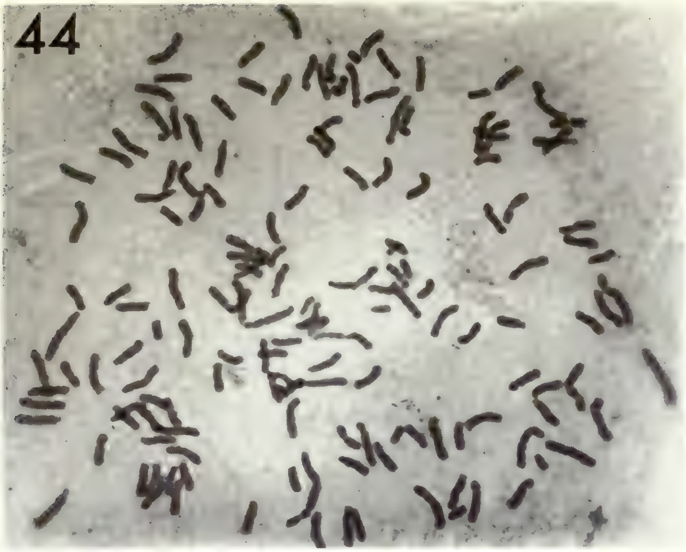
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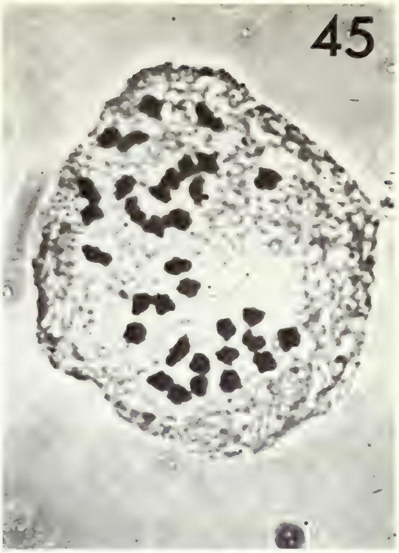
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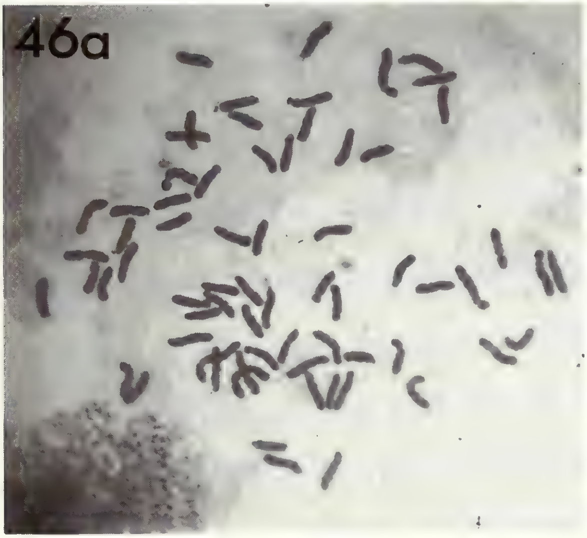
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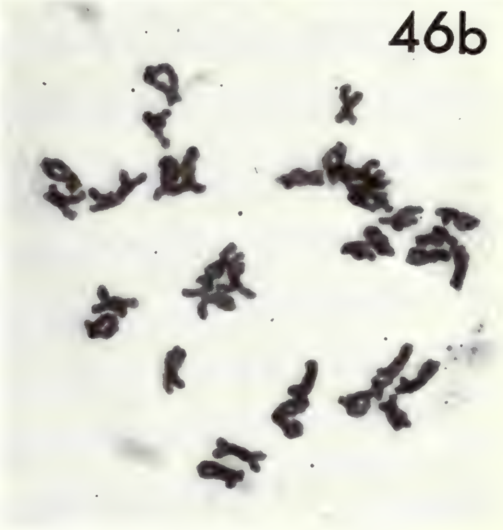
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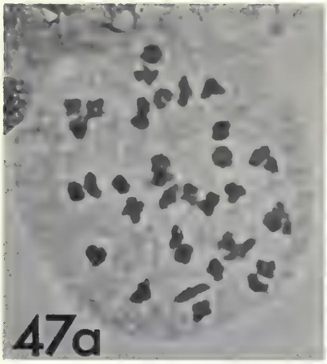
Plate X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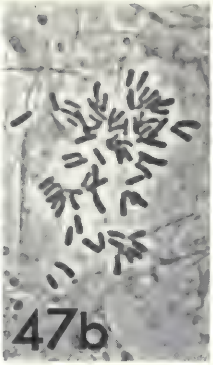
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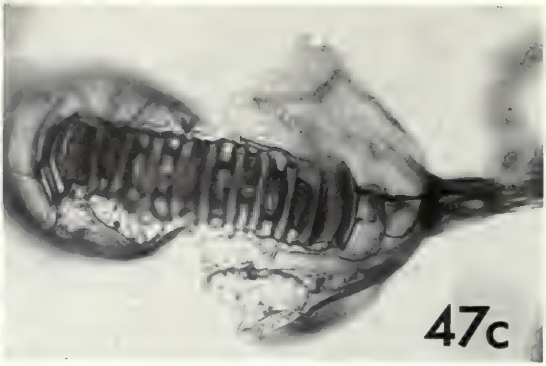
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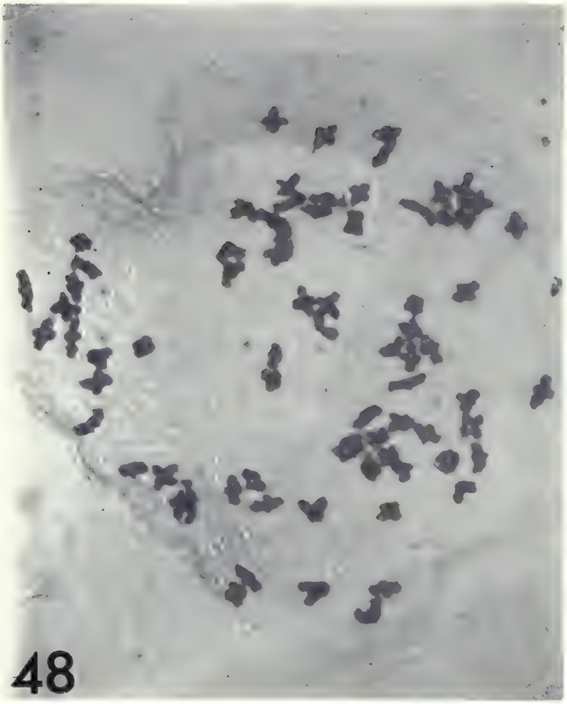
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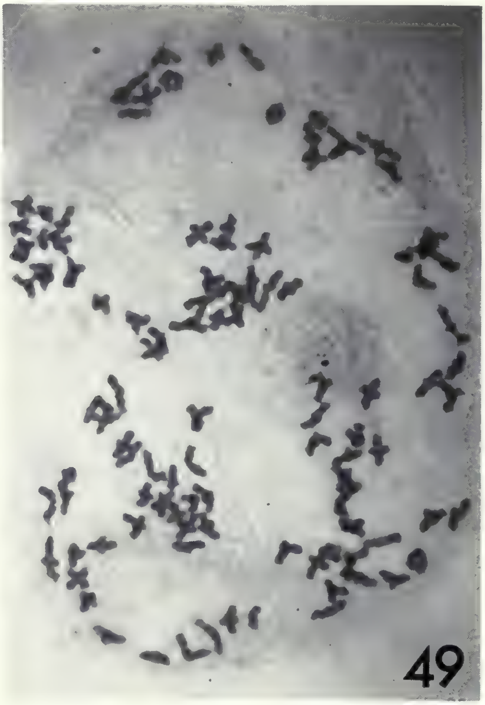
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Plate XI

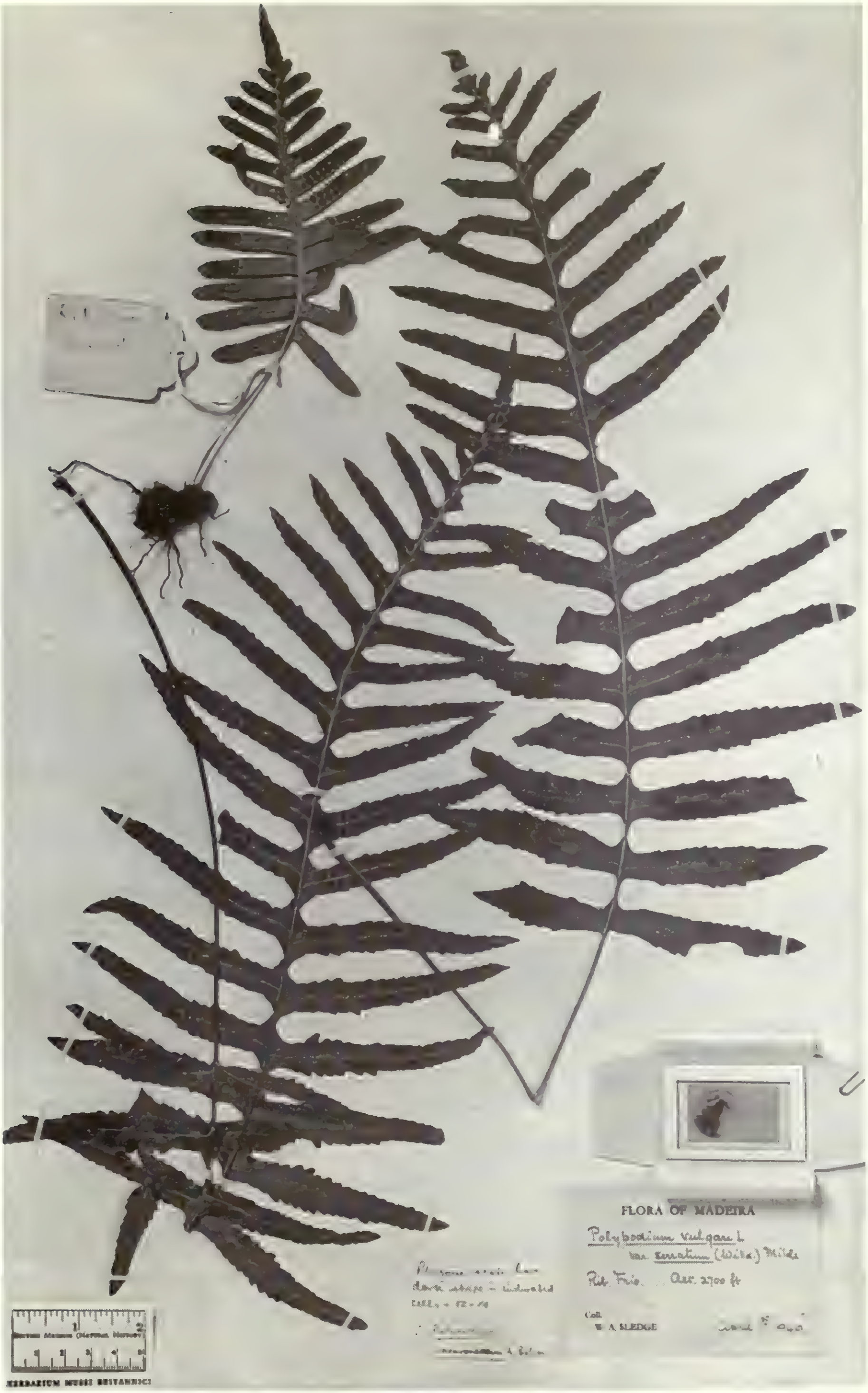
FLORA OF MADEIRA
Polypodium vulgare L
var. serratum (Willd.) Milde
Rib. Frio. Alt. 2700 ft
Coll.
W. A. SLEDGE
HERBARIUM MUSEI BRITANNICI

Plate XII

British Museum (Natural History)

Ferns of Jamaica
A guide to the Pteridophytes

G. R. Proctor

This flora records and describes the 579 species and 30 varieties of ferns occurring in Jamaica. The succinct species descriptions include relevant synonymy and incorporate distributional data both within and outside Jamaica. Special emphasis is given to the subtle distinctions between closely related species and all genera are illustrated. Keys to the genera and species facilitate a wider use of the flora in the West Indies and northern South America. The author, one time Senior Botanist in charge of the Herbarium of the Science Museum, Kingston, Jamaica, is an outstanding field botanist and his expertise is reflected in the practicality of the flora and especially in the habitat and ecological information. This volume represents an important addition to our knowledge of the flora of the West Indies.

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Bulletin of the British Museum (Natural History)

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J. A. Elix, J. Johnston and
P. A. Armstrong

Botany series Vol 15 No 3 18 December 1986

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A revision of the lichen genus *Xanthoparmelia* in Australasia

John A. Elix, Jen Johnston and Patricia M. Armstrong

Chemistry Department, The Faculties, Australian National University, G.P.O. Box 4,
Canberra, A.C.T. 2601, Australia

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Synopsis

The Australian; New Zealand, and Papua New Guinean representatives of the lichen genus *Xanthoparmelia* are revised. Keys and descriptions for the 117 species are given, and the chemistry, distribution, ecology, and taxonomic affinities of each species are discussed.

Xanthoparmelia alexandrensis, X. alternata, X. aurifera, X. centralis, X. concomitans, X. crateriformis, X. cravenii, X. dissitifolia, X. donneri, X. dubitata, X. examplaris, X. ferruma, X. filsonii, X. gongylodes, X. hypomelaenoides, X. immutata, X. iniquita, X. laxencrustans, X. louisii, X. nashii, X. norpumila, X. parvoincerta, X. rogersii, X. rupestris, X. spargenosa, X. tegeta, X. verdonii, X. verruciformis, X. vicaria, and *X. xerophila* are described as new. New names are given to *Xanthoparmelia eilifii* and *X. succedans* (formerly *Parmelia dahlii, P. adpressa* respectively). New combinations in the genus are proposed for *Parmelia amplexula* Stirton, *P. antleriformis* Elix, *P. bellatula* Kurok. & Filson, *P. bungendorensis* Elix, *P. congesta* Kurok. & Filson, *P. consociata* Elix, *P. constipata* Kurok. & Filson, *P. dayiana* Elix & P. Armstr.. *P. elaeodes* Elix, *P. erosa* Elix & P. Armstr., *P. everardensis* Elix & P. Armstr., *P. exillima* Elix, *P. flindersiana* Elix & P. Armstr., *P. glareosa* Kurok. & Filson, *P. incerta* Kurok. & Filson, *P. incrustata* Kurok. & Filson, *P. conspersa* v. *laxa* f. *isidiigera* Müll. Arg., *P. conspersa* v. *stenophylla* f. *isidiosa* Müll. Arg., *P. mannumensis* Elix, *P. metaclystoides* Kurok. & Filson, *P. nebulosa* Kurok. & Filson, *P. neotinctina* Elix, *P. norconvoluta* Elix & P. Armstr., *P. pertinax* Kurok. & Filson, *P. phillipsiana* Filson, *P. praegnans* Elix & P. Armstr., *P. pseudoamphixantha* Elix, *P. pseudohypoleia* Elix, *P. pumila* Kurok. & Filson, *P. pustuliza* Elix, *P. remanens* Elix, *P. reptans* Kurok., *P. streimannii* Elix & P. Armstr., *P. terrestris* Kurok. & Filson, *P. ustulata* Kurok. & Filson, *P. willisii* Kurok. & Filson, and *P. xanthosorediata* Elix.

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In total 117 species are recognized from Australia, 47 from New Zealand, three from Papua New Guinea, one from Fiji, and one from Norfolk Island.

Introduction

Species of the genus *Xanthoparmelia* are the most prominent macrolichens present on rocks and soil in dry areas of southern Australia and South Island, New Zealand. These common yellow-green foliose lichens, which owe their colour to the presence of usnic acid in the upper cortex, possess a simple but highly variable morphology. Significant morphological features include presence or absence of soredia, isidia, dactyls, lobules, or maculae, colour of the lower surface, configuration of the lobes, and the degree of adnation of the thallus. The growth form of some species may be significantly influenced by environmental factors since *Xanthoparmelia* inhabits desert, semi-arid, and even alpine habitats, so that this feature must be interpreted with considerable caution.

The chemistry of *Xanthoparmelia* is particularly diverse with over 50 different combinations of taxonomically important secondary products. As most chemically characterised populations have morphological or distributional characteristics which justify their ranking as species, a chemotaxonomic approach is required.

Xanthoparmelia is characteristic of open habitats of arid and semi-arid regions, and, although absent from limestones, may cover vast areas of exposed sediments or volcanic rocks. Species are absent from moist lowland tropical forests (Hale 1971*a*) as well as other dense forests, but a few are characteristic of alpine habitats. Most species of *Xanthoparmelia* are restricted to saxicolous substrates, some to open consolidated soils, but a few occasionally occur on decorticated wood or man-made substrates such as asphalt, glass, and steel cans.

The genus *Xanthoparmelia* is probably the dominant group of foliose saxicolous lichens in hot, semi-arid climates of the world. The major centre of speciation appears to be in the Southern Hemisphere with over 100 species recognized in Australia, and 60 in southern Africa, although 40 species are also known from North America.

History of the taxonomy

Lichens now placed in the genus *Xanthoparmelia* were first segregated by Nylander (1860: 391) who placed them in his 'Stirps *Parmeliæ conspersæ*'. This subdivision was subsequently formalised by Vainio (1890). Vainio divided *Parmelia* subgen. *Euparmelia* into sections *Amphigymnia* Vainio, *Hypotrachyna* Vainio, and *Xanthoparmelia* Vainio, utilizing the latter section to accommodate all narrow-lobed, yellow-green species. The yellow or yellow-green colour is now known to be due to the cortical pigment usnic acid, but by using this sole criterion, Vainio grouped together several diverse taxa. In addition to typical saxicolous species with simple rhizines such as *Xanthoparmelia conspersa* (Ach.) Hale, he included species such as *Parmelia flavida* Zahlbr. and *P. velloziae* Vainio, both of which have dichotomously branched rhizines (and are now included in *Hypotrachyna*), and *Parmelia abstrusa* Vainio, which has bulbate cilia (now included in *Relicina*).

Recent workers have utilized cilia, rhizine morphology, and substrate ecology to refine Vainio's concept. Thus Hale (in Hale & Kurokawa, 1964) included in *Xanthoparmelia* only those saxicolous and terricolous species with predominantly simple rhizines, no marginal cilia, and usnic acid in the cortex. Hale (Hale & Kurokawa, 1964) elevated section *Xanthoparmelia* to *Parmelia* subgen. *Xanthoparmelia* and nominated *Parmelia conspersa* Ach. as type species.

Parmelia sens. lat., was subsequently divided into several genera (Hale, 1974*a*, 1974*b*, 1974*c*, 1974*d*, 1976*b*; Esslinger, 1978; W. L. Culberson & C. F. Culberson, 1981; Krog, 1982*b*) but these were not accepted by some lichenologists (Beltman, 1978; Krog & Swinscow, 1979; Elix & Stevens, 1979; Kurokawa, 1980; Elix, 1981). Hale proposed the genus *Xanthoparmelia* (Vainio) Hale (1974*d*), where he retained the above interpretation.

In previous publications on *Parmelia* subgen. *Xanthoparmelia* in Australia and New Zealand (Elix, 1976, 1981; Elix & Armstrong, 1983), we hesitated to adopt generic status for the subgenus. Although we were convinced that *Xanthoparmelia* constituted a well-defined natural group distinct from *Parmelia* sens. str. (i.e. the pseudocyphellate *Parmelia saxatilis* group), we felt that it was not yet satisfactorily circumscribed, notably in relation to *Pseudoparmelia* and *Neofuscelia* (or alternatively *Parmelia* subgen. *Cyclocheila* and *Neofusca* respectively).

In Australia and South Africa, *Pseudoparmelia* and *Neofuscelia* are also well-developed on rocks in the same areas and exhibit striking morphological parallels with species of *Xanthoparmelia*. As they also have simple rhizines, lack marginal cilia, and rarely produce soredia, Hale (1976*a*) suggested they might represent an example of convergent evolution of the three genera in these stressed environments. However morphological parallels between species of these 'genera' could equally well be attributed to divergent chemical evolution of the upper cortex from that of common ancestral taxa, the remaining similarities being the result of retarded morphological evolution.

Studies of conidia in the parmelioid lichen genera by Hale (personal communication), Krog (1982*a*) and Krog & Swinscow (1983), have confirmed the previous segregation of a number of these genera and led to the recognition of *Punctelia* (Krog, 1982*b*). However, such investigations did not differentiate *Xanthoparmelia, Pseudoparmelia*, and *Neofuscelia*. In fact here the generic segregation hinges on the chemical constituents of the upper cortex, and this could well be considered inadequate grounds. Given this premise, one would expect *Pseudoparmelia* to have priority of the alternative generic names available. However, *Pseudoparmelia* is a heterogeneous assemblage of species (Hale, 1975) and taxa of *Xanthoparmelia* are not closely related to all subgroups. In particular, they are dissimilar from typical corticolous taxa, as exemplified by the type species, *Pseudoparmelia cyphellata* Lynge.

In the present revision, *Xanthoparmelia* is recognized as a distinct genus. We currently accept the more restricted view of Hale (1974*d*), where the genus is considered to include only yellow-green saxicolous and terricolous species with usnic acid in the upper cortex. The majority of such species have a distinctive morphology and ecology, a detailed discussion of which follows. Whether or not this genus will ultimately accommodate grey and brown, usnic acid deficient, saxicolous species remains to be determined.

Morphology

1. Thallus adnation and growth form

The species of *Xanthoparmelia* exhibit considerable variability in growth form and degree of adnation of the thalli – from loosely adnate, large foliose thalli 30 cm in diameter (*X. flavescentireagens*), similar large, tightly adnate species (e.g. *X. lineola*) to diminutive, subcrustose adnate species (e.g. *X. adhaerens*), or unattached lobules (*X. pumila*, *c.* 0·5 cm diam.).

It would appear that one of the major areas of morphological evolution in *Xanthoparmelia* has been in the adnation of the thallus (Hale 1971*a*). Although the majority of species considered in this revision are distinctly foliose, at least 16 species grow so closely appressed and tightly adnate (and usually more or less centrally areolate) as to be considered subcrustose. These include *X. adhaerens, X. consociata, X. crateriformis, X. cravenii, X. dayiana, X. donneri, X. dubitata, X. exillima, X. isidiosa, X. laxencrustans, X. louisii, X. mougeotina, X. neorimalis, X. oleosa, X. praegnans,* and *X. xerophila*. At the other extreme are foliose species, completely unattached to the substrate; these include the convolute-lobed species *X. australiensis, X. erosa, X. convoluta,* and *X. norconvoluta,* and a fifth terricolous species, *X. willisii*.

In the present work the terms *appressed* and *adnate* are used in the sense outlined by Esslinger (Esslinger, 1977: 9). Thus the term appressed describes the closeness with which the thallus fits against the substrate (or conversely, the degree to which the thallus tends to be raised from the substrate) whereas the term adnate describes the actual degree of physical attachment of the thallus to the substrate. A loosely adnate thallus, although attached to the substrate, can be removed readily more or less intact, whereas a tightly adnate thallus can only be removed from the substrate with difficulty and so results in considerable or complete fragmentation of the thallus in some situations.

The degree of adnation of the thallus is considered to be an important species character. The following seven pairs of species are chemically and morphologically similar to one another, but differ primarily in the degree of adnation (and often an accompanying difference in thalline habit):

Loosely adnate	Tightly adnate
X. bungendorensis	*X. cravenii*
X. elixii	*X. metaclystoides*
X. flavescentireagens	*X. filarszkyana*
X. iniquita	*X. pertinax*
X. rogersii	*X. hypomelaenoides*
X. taractica	*X. lineola*
X. tasmanica	*X. incerta*

The relatively low number of species with counterparts having alternative adnation would seem to support the consideration of this trait as a species level character.

2. Lobe configuration

Considerable variation in the lobe configuration exists; lobes may be plane, or convex with a canaliculate lower surface, revolute, or markedly convolute and contorted.

Further, plane-lobed species range from conspersoid (short, broad lobes with rotund apices, as in *X. conspersa* (Ach.) Hale) to stenophylloid (with elongate, narrow lobes, as in *X. dichotoma*). Extremes of development may be observed by comparing such species as *X. tasmanica* (with broad, irregularly branched, rotund lobes to 10 mm wide) and *X. dichotoma* (with narrow, dichotomously divided, linear-elongate lobes *c.* 1 mm wide and up to 10 mm between the lobe-branches). However, a number of species of *Xanthoparmelia* have a highly plastic morphology and their lobe configuration may be significantly influenced by environmental factors. For example, in some situations *X. tasmanica* may exhibit irregularly elongated lobes, approximately 1·0–1·5 mm wide with subdichotomous branching!

Twelve Australian species are characterised by convolute or markedly revolute lobes, and these occur unattached or very loosely adnate to soils in subarid or arid areas. The revolute species include *X. alternata, X. eilifii, X. molliuscula, X. norpumila, X. pumila, X. subdistorta, X. terrestris* and *X. versicolor* and the convolute species, *X. australiensis, X. convoluta, X. erosa,* and *X. norconvoluta* as mentioned above. A further group of terricolous species, exemplified by *X. amphixantha*, are loosely attached, have a canaliculate lower surface and a weakly convex upper surface.

In some saxicolous species the lobes become highly imbricate and compact, forming a dense mat of thallus, whereas most species lack such lobes. In others lobes may become suberect or raised at the apices, but in the majority they are appressed and plane.

Occasionally there exists an obvious and consistent distinction between the primary and secondary lobes of the thallus, and this feature may sometimes be used for distinguishing taxa at the species level. Secondary lobes are, in general, adventitious lobes which develop from the centre of the thallus or originate from along the margins of the older, primary lobes. *X. incrustata*, for instance, has flat, rotund, tightly adnate primary lobes, but develops markedly convex, sublinear-elongate, loosely adnate secondary lobes. This is a consistent feature of this species, and distinguishes it from the related *X. filarszkyana*.

Lobes of *Xanthoparmelia* have no ornamentation (cilia), the margins being smooth and commonly black-rimmed.

3. Lower surface

The lower surface of the thallus in *Xanthoparmelia* varies in colour from off-white (pale ivory) to jet black and such colour differences are a very important taxonomic character. Contrasting darker colours are frequently present in a narrow zone at the apices and along the margins of the lobes, but the rest of the lower surface is usually very consistent. Even so, variation from pale brown to dark brown in some species may be somewhat confusing (e.g. in *X. scabrosa*), as is variation from jet black to brown black in others (*X. dichotoma, X. versicolor*).

In his treatment of *Parmelia* sens. lat. in southern Australia, Filson (1982) considered the colour of the lower surface to be an important species character, and segregated three groups of species on this basis. Thus the lower surface could be pale ivory to light brown (light brown being more white than brown), brown to dark brown (brown being distinctly brown with no trace of white, dark brown being almost black but still distinctly brown), or definitely black. In the present treatment we have used a similar terminology, but for the purpose of the keys and as a primary species character we consider only two categories, namely those species with a pale to brown lower surface, and those with a definitely black lower surface.

Of the 117 species described, 45 have a black lower surface and 72 have a pale tan or brown lower surface. The following 12 pairs of species are chemically and morphologically similar to one another but differ primarily in the colour of the lower surface:

Pale below	Black below
X. alternata	*X. versicolor*
X. amplexula	*X. thamnoides*
X. centralis	*X. vicaria*
X. filarszkyana	*X. elaeodes*
X. flindersiana	*X. pustuliza*
X. furcata	*X. dichotoma*
X. lineola	*X. incerta*
X. mexicana	*X. australasica*
X. praegnans	*X. isidiosa*
X. scabrosa	*X. verdonii*
X. streimannii	*X. neotinctina*
X. tucsonensis	*X. everardensis*

The relatively large number of species without counterparts having the alternative colour of the lower surface would seem to support the validity of this trait as a species-level character.

The nature of the lower surface is also occasionally characteristic for some species, i.e. it may be smooth (as in *X. cheelii*) or rugulose and wrinkled (as in the related species, *X. eradicata*).

4. Rhizines

Rhizines in genus *Xanthoparmelia* are predominantly simple and may be very sparse to abundant. Four exceptions to this are *X. barbellata, X. glareosa, X. metastrigosa,* and *X. substrigosa* where rhizines are regularly dichotomously branched. Several other species, including *X. arapilensis, X. iniquita, X. molliuscula,* and *X. taractica*, have occasional dichotomously branched rhizines, but the rhizines in the remaining species are simple.

Even so, the form and the density of the simple rhizines are usually characteristic for any given species and constitute a significant character. Simple rhizines may be dense, moderate, or sparse, and may vary in form from long, slender and tapering, to short, robust and tufted. Disposition of rhizines is also of some significance – for instance they may be grouped subapically, randomly scattered, or apices may be erhizinate.

5. Maculae

Maculae are submacroscopic pale spots or areas resulting from discontinuities in the algal layer immediately below the upper cortex. These impart a spotted, mottled, or marbled appearance to the thallus.

Two types of maculae are observed in *Xanthoparmelia*. (i) Effigurate maculae are particularly prominent and extensive and readily observed with ×10 lens, particularly when the thallus is wet. Here the upper surface has an overall mottled or marbled appearance, with the maculae forming a pattern throughout. Effigurate maculae are a constant character in a number of species and are useful for separating taxa at the species level. Effigurate maculae are particularly prominent in the *X. hypoleia* group (*X. burmeisteri, X. hypoleia, X. hypoprotocetrarica, X. mannumensis, X. notata,* and *X. pseudohypoleia*), in some members of the *X. amphixantha* group (*X. amphixantha, X. pseudoamphixantha, X. reptans,* and *X. willisii*) and in *X. meta-*

morphosa. (ii) Spotted maculae are much smaller, less obvious, discontinuous and appear intermittently in some species and are deemed to be taxonomically insignificant. They arise from minor interruptions in the algal layer and are occasionally observed in *X. barbellata, X. arapilensis, X. subnuda,* and *X. substrigosa* among other species.

6. Soredia

Soralia are relatively rare in *Xanthoparmelia* and in Australasia only four species are truly sorediate. *X. xanthosorediata* has soralia initiated by a small pore in the upper cortex. As pore size increases and soredia are produced, an orbicular, slightly raised soralium results, which may in turn coalesce with adjacent soralia to cover larger areas of the upper surface.

In *X. erosa* the upper cortex erupts and becomes sorediate, the soredia developing in the cracks and fissures. Ultimately the upper cortex erodes and becomes extensively covered with granular soredia.

By contrast, in two other sorediate terricolous species, *X. aurifera* and *X. concomitans*, lobe apices become swollen and develop terminal, subcapitate soralia which only rarely spread along the lobe margins.

7. Isidia

Dactyl was introduced by Swinscow & Krog (1978) for isidia-like appendages whose main function was suggested to be gas exchange rather than propagation. Dactyls may be simple or branched, dactyliform, claviform, or merely crescent-shaped folds in the upper cortex and underlying tissue. The surface is erose or granulate and differs markedly from the hard, often shiny upper cortex of the rest of the thallus. Two Australian species have dactylate isidia, namely *X. cordillerana* and *X. pustuliza*, where the upper surface of the isidium becomes erose and granulate and the hollow appendage utlimately bursts open at the apex, shedding corticate fragments from its rim. The resulting efflorescent growth of more or less fragmenting tissue which is formed often appears sorediate and gives the impression of sorediate pustules. *X. scabrosa* also exhibits open dactylate isidia of this type but the production of dactylate isidia often occurs together with erumpent isidia. The latter appendages arise as subglobose isidia which grow vertically to forming subcylindric isidia inflated at the apices (but lacking the erose, granulate upper cortex), and ultimately burst open leaving crater-like impressions in the apex of the isidium but are not at all sorediate. Some specimens of *X. scabrosa* produce only erumpent isidia and no dactylate isidia. Thirteen other species produce such erumpent isidia: *X. alexandrensis, X. centralis, X. constipata, X. crateriformis, X. dayiana, X. exuviata, X. flindersiana, X. globulifera, X. praegnans, X. isidiosa, X. remanens, X. verdonii,* and *X. weberi*.

Normal corticate isidia are very common in *Xanthoparmelia* and 21 isidiate species are recognized in this revision. Isidia may be globose (as in *X. mougeotina*), to regular cylindrical (as in *X. isidiigera*), to extensively branched, coralloid (as in *X. antleriformis*). Although numbers and density of isidia produced by a species may vary considerably, their shape and size range are almost invariably characteristic of the species producing these structures. The concept of pairs of species that are chemically and morphologically identical except for the production of vegetative propagules by one has received considerable recent attention (Poelt, 1970, 1972; Tehler, 1983).

In *Xanthoparmelia* good examples of this phenomenon are rather infrequent for in few cases are the members of such pairs really morphologically identical. Chemically identical pairs (or trios) of species differing primarily in the presence or absence of either cylindrical or erumpent isidia are listed in Table 1. However, it should be emphasised that these are not all morphologically identical but show varying degrees of differentiation of other morphological characters in addition to the presence or absence of vegetative propagules.

8. Lobules

Lobule usually refers to dorsiventral isidioid structures (phyllidia), ranking with soredia and isidia as a class of vegetative propagule. Such phyllidia are unknown in the Australasian

Table 1 Chemical and morphological data for comparable species-pairs of *Xanthoparmelia* in Australasia.

Chemistry	Primary species (fertile – lacking isidia)	Secondary species: With regular isidia	Secondary species: With dactylate or erumpent isidia
Barbatic acid	*X. barbatica*		*X. centralis*
	X. louisii	*X. xerophila*	
Diffractaic acid	*X. everardensis*	*X. nashii*	
Norlobaridone, loxodin	*X. flavescentireagens*	*X. amplexula*	*X. scabrosa*
	X. elaeodes	*X. thamnoides*	*X. verdonii*
	X. dubitata	*X. exillima*	
Hypoprotocetraric acid	*X. subdomokosii*		*X. weberi*
Hypostictic and hyposalazinic acids	*X. subcrustacea*	*X. gongylodes*	
Norstictic acid	*X. congesta*	*X. neotinctina*	
	X. metaclystoides		*X. flindersiana*
	X. subnuda		*X. alexandrensis*
Stictic acid	*X. adhaerens*	*X. mougeotina*	*X. crateriformis*
Salazinic acid	*X. tasmanica*	*X. australasica*	
	X. incerta	*X. isidiigera*	
	X. lineola	*X. mexicana*	*X. cordillerana*
	X. neorimalis		*X. praegnans*
Scabrosin derivatives	*X. bungendorensis*		*X. remanens*
	X. cravenii	*X. immutata*	
Constipatic, protoconstipatic acids	*X. oleosa*		*X. globulifera*
Exuviatic acids	*X. spargenosa*		*X. exuviata*

Xanthoparmeliae, but seven species (namely *X. alternata, X. eilifii, X. molliuscula, X. pumila, X. norpumila, X. terrestris,* and *X. versicolor*) bear lobules of a different nature in the central part of the thallus. These lobules are highly branched, diminutive secondary lobes, which are often ascending and usually subterete and circular in cross-section. They are generally restricted to the above seven terricolous species, although several other species (*X. convoluta, X. cordillerana*) occasionally do bear lobulae.

9. Apothecia

Apothecia are known in 89 of the 117 Australasian species described, and their size range and shape are generally characteristic of a particular species. Even so these characters are quite variable and must be interpreted carefully. Moreover apothecia occur erratically in many species, and their production is correlated inversely with the production of various asexual propagules, a relationship observed in many other groups of lichens. In particular, apothecia are rare or unknown in a number of isidiate species and in the terricolous species that commonly propagate via fragmentation (*X. amphixantha* and related species, *X. convoluta, X. molliuscula*, and *X. sulcifera*).

Internal apothecial characteristics and spore characters appear to be of limited use in the delimitation of species. These are primarily correlative characters and in no cases were species recognized on the basis of hymenial-subhymenial measurements or spore size alone. Spores in the group are uniformly colourless, ellipsoid, 5–12 × 3–6 μm, ± uniseriate, and 8 per ascus.

10. Pycnidia

Pycnidia are very similar in most species of *Xanthoparmelia* and are found immersed in the upper surface of the lobes. In most species the cortex is somewhat blackened around the pycnidial ostiole. As a general rule species which are fertile also produce pycnidia on the upper surface, although pycnidia occasionally are seen on sterile plants.

The microconidia are remarkably uniform throughout the genus, usually being weakly bifusiform or cylindrical, 4–5 μm long and *c.* 1 μm wide. Krog (1982*a*) has noted significant markings on the conidia in some species.

Internal structure

The internal structure of *Xanthoparmelia* presents no unusual features (Hale, 1973). The upper cortex has a palisade plectenchyma which is overlain by a thin, pored epicortex. The lower cortex is paraplectenchymatous and in these respects it is identical with other epicorticate parmelioid genera (Hale, 1973).

Chemistry

The chemistry of *Xanthoparmelia* is particularly diverse and has proved to be of greater taxonomic value here than in many other lichen groups (Hale, 1971*a*; Nash, 1973, 1974*a, b, c*; Kurokawa & Filson, 1975; Elix, 1976, 1981; Filson, 1982; Elix & Armstrong, 1983).

Gyelnik (1931, 1932, 1934, 1935, 1938*a*, 1938*b*) was one of the first lichenologists to make extensive use of chemical tests in this genus and, although his work later fell into disrepute, a number of his taxa are now accepted as valid species. Thus, specimens previously thought to represent chemical races have, in many cases, been shown to have morphological or distributional characteristics which justify species rank.

In the present work all species were tested by thin-layer chromatography using solvent systems A and C of C. F. Culberson (1972), B of Culberson & Johnson (1982) and system G (C. F. Culberson, W. L. Culberson & Johnson, 1981), and by comparison with authentic synthetic compounds. Lichen substances found in the Australasian species of *Xanthoparmelia* are listed (Table 2) under the presently accepted classification, with the number of species containing each substance in parentheses; t.l.c. data for the substances is presented in Table 3.

The β-orcinol depsidones form by far the most important group of secondary metabolites found in *Xanthoparmelia*, with salazinic acid and norstictic acid being particularly common. These depsidones are widely distributed compounds occurring commonly in numerous lichen genera.

The orcinol depsidones, loxodin and norlobaridone, are also very common in Australasian species of *Xanthoparmelia*. They occur in the widespread *X. scabrosa* (ranging from Papua New Guinea, Fiji, northwest to Japan and with sporadic occurrence in Africa) and a total of 15 other species endemic to the region.

In addition to usnic acid, loxodin, and norlobaridone, *X. xanthosorediata* produces conloxodin, conorlobaridone, and the aliphatic acids constipatic acid and protoconstipatic acid (Begg, Chester & Elix, 1979; Chester & Elix, 1979*b*).

According to the hypotheses of progressive chemical evolution towards shorter side chains in phenolic metabolites (C. F. Culberson & W. L. Culberson, 1977) and morphological evolution

Table 2 List of lichen substances found in the Australasian species of *Xanthoparmelia*.

Substance	**Number of species**
ALIPHATIC ACIDS	
Constipatic acid	(22)
Dehydroconstipatic acid	(3)
Pertusaric acid	(2)
Exuviatic acids A & B	(2)
Protoconstipatic acid	(20)
AMINO ACID DERIVATIVES	
Scabrosin 4-acetate-4′-butyrate	(11)

Table 2 – *cont.*

Substance	**Number of species**
AMINO ACID DERIVATIVES – *cont*	
Scabrosin 4-acetate-4′-hexanoate	(11)
Scabrosin 4,4′-diacetate	(10)
Scabrosin 4,4′-dibutyrate	(11)
AROMATIC COMPOUNDS	
Orcinol depsidones and related derivatives	
Conloxodin	(4)
Conorlobaridone	(5)
Loxodin	(16)
Norlobaridone	(18)
Norlobariol	(2)
Isonorlobaridone	(2)
Norlobariol methyl ester	(3)
β-*Orcinol depsides*	
Barbatic acid	(10)
4-*0*-Demethylbarbatic acid	(9)
Diffractaic acid	(4)
3-α-Hydroxybarbatic acid	(5)
Norobtusatic acid	(1)
Obtusatic acid	(1)
Squamatic acid	(2)
β-*Orcinol depsidones*	
Connorstictic acid	(20)
Consalazinic acid	(30)
Constictic acid	(10)
Cryptostictic acid	(10)
4-*0*-Demethylnotatic acid	(2)
Fumarprotocetraric acid	(9)
Physodalic acid	(1)
Hypoconstictic acid (= unknown PQ4)	(5)
Hypoprotocetraric acid	(5)
Hyposalazinic acid	(6)
Hypostictic acid	(5)
Isonotatic acid	(1)
4-*0*-Methylhypoprotocetraric acid	(3)
Norstictic acid	(36)
Notatic acid	(1)
Protocetraric acid	(11)
Pseudostictic acid	(2)
Salazinic acid	(41)
Stictic acid	(10)
Subnotatic acid	(1)
Succinprotocetraric acid	(8)
Virensic acid	(1)
Dibenzofurans	
Usnic acid	(117)
Anthraquinones	
Skyrin	(3)

towards asexual propagation of lichens (Poelt, 1970, 1972), it would appear that *X. xanthosorediata* is an evolutionarily advanced species on both counts. This is indicated by the presence of soredia and the production of conloxodin and conorlobaridone, since these depsidones have a

Table 3 TLC data for *Xanthoparmelia* metabolites – in solvent A (benzene:dioxane:acetic acid, 180:45:5), B (hexane:methyl *t*-butyl ether:formic acid, 140:72:18), C (toluene:acetic acid, 100:15), and G (toluene:ethyl acetate:formic acid, 139:83:8).

	$R_f \times 100$			
Substance	A	B	C	G
Consalazinic acid	2	1	0	6
Fumarprotocetraric acid	1	26	7	31
Protocetraric acid	3	19	4	27
Succinprotocetraric acid	4	18	10	26
Constictic acid	7	1·5	2	10
Cryptostictic acid	14	10	10	27
Hypoconstictic acid	15	7	4	28
Salazinic acid	10	7	4	26
Connorstictic acid	11	11	3	26
Squamatic acid	10	25	25	39
4-*0*-Demethylnotatic acid	16	33	14	46
Menegazziaic acid	19	15	11	32
Stictic acid	32	9	18	31
Hyposalazinic acid	34	26	8	44
Hypoprotocetraric acid	25	37	22	48
Notatic acid	24	46	38	55
Virensic acid	26	56	38	56
Norstictic acid	40	32	30	57
Hypostictic acid	50	32	32	61
Isonotatic acid	38	42	43	56
4-*0*-Methylhypoprotocetraric acid	35	53	45	61
Subnotatic acid	25	37	36	48
Physodalic acid	10	33	19	46
Norobtusatic acid	27	48	30	
Protoconstipatic acid	26	17	26	
Constipatic acid	31	27	29	
Obtusatic acid	35	63	48	
Scabrosin 4,4′-diacetate	50	3	33	
4-0-Demethylbarbatic acid	39	52	39	
Pertusaric acid	37	33	32	
Dehydroconstipatic acid	40	35	35	
Scabrosin 4-acetate-4′-butyrate	57	7	40	
Skyrin	44	36	23	
Scabrosin 4-acetate-4′-hexanoate	61	13	43	
Scabrosin 4,4′-dibutyrate	65	19	46	
Diffractaic acid	44	55	51	
Barbatic acid	44	67	52	
Norlobaridone	50	36	21	
Loxodin	58	40	35	
Ursolic acid	59	48	52	
Usnic acid	70	65	71	
Conloxodin	50	31	32	
Conorlobaridone	43	33	14	
Exuviatic acid B	50	35	40	
Exuviatic acid A	53	42	44	
Isonorlobaridone	31	14	5	
Norlobariol	12	18	1	
Norlobariol methyl ester	28	23	3	

3-carbon side chain in ring-B rather than the 5-carbon chain of loxodin and norlobaridone (Elix, 1981).

The aliphatic acids, constipatic acid and protoconstipatic acid are also quite common metabolites but are often accessory in nature (see discussion below). They appear to be more common in specimens collected in arid areas. The structure of the aliphatic acids, exuviatic acid A and exuviatic acid B, are not yet elucidated.

Scabrosin metabolites are unique amino-acid derivatives which were first isolated from a chemical race of *X. scabrosa* (Begg, Elix & Jones, 1978) and are quite widespread in *Xanthoparmelia*. These compounds also occur in *Neofuscelia* (C. F. Culberson, W. L. Culberson & Esslinger, 1977).

Chemistry and the species concept

Most morphologically defined lichen species have a constant chemistry, usually one cortical substance (usnic acid in *Xanthoparmelia*) and one or more medullary substances. The chemical variation within a morphological entity may involve replacement type compounds, accessory type compounds, or chemosyndromic variation. *Xanthoparmelia* exhibits all three patterns of chemical variation and these are discussed separately.

(i) *Replacement compounds and chemosyndromic variation*

This mode of chemical variation involves a complete substitution of the principal or diagnostic components present in the chemotypes. In *Xanthoparmelia* such chemical variation was initially elucidated by the pioneering work of Hale (1955, 1964), but the classical example of replacement compounds is that of the chemical races in *Pseudevernia furfuracea* (Hale, 1956, 1968). From all appearances these lichen populations are morphologically indistinguishable but have variable chemical compositions. The three chemical strains contain:

(i) olivetoric acid (ii) physodic acid	Europe
(iii) lecanoric acid –	North America

Biosynthetically the first two strains appear very closely related (i.e. they are biosequential metabolites) but the third is quite remote. It is now generally accepted that when there is such a geographical and biosynthetic demarcation, these taxa should be recognised as species and the North American taxon is distinguished as *Pseudevernia consocians*. In fact the geographical distribution of chemical races (i) and (ii) differed significantly within Europe (Hale, 1956, 1968; Hawksworth & Chapman, 1971) and it was suggested by Hawksworth (1976) that these two chemical strains should be recognised as varieties. However the discovery that approximately 10% of specimens collected from a single population in Spain (C. F. Culberson, 1965) exhibited joint occurrence of both acids (i.e. a chemical combinant) convinced many lichenologists that these strains represent a single species showing some genetic variation (Dahl & Krog, 1973). In fact, most lichen taxonomists who have chosen to recognize chemically distinct races as species have supported their decision primarily on the basis of the different geographic distributions that such races usually show.

It has been suggested that the best evidence that chemical variation is under genetic control rather than being environmentally determined is the fact that chemical races, where sympatric, maintain their distinctness even when growing side by side (W. L. Culberson, 1967, 1969; W. L. Culberson & C. F. Culberson, 1967; Elix, 1982). Alternatively the occurrence of intermediates in areas of sympatry confirms that such races belong to a single species.

The existence of chemosyndromic variations in some groups of lichens can make the recognition of intermediates more difficult (C. F. Culberson & W. L. Culberson, 1977, 1978; C. F. Culberson, W. L. Culberson & Esslinger, 1977; C. F. Culberson, Nash & Johnson, 1979). A chemosyndrome refers to a group of biosynthetically related metabolites and in this pattern of chemical variation the major secondary metabolite in any one taxon is *invariably* accompanied by minor quantities of several biosequentially related substances, which in turn are observed as major metabolites in related taxa.

For example, species belonging to the *Xanthoparmelia hypoleia* complex exhibit both replacement compounds and chemosyndromic variations. Thus:

X. burmeisteri contains barbatic acid (major) and 4-*0*-demethylbarbatic acid (minor).
X. mannumensis contains diffractaic acid (major), barbatic acid (minor), 4-*0*-demethylbarbatic acid (traces), obtusatic acid (trace), and norobtusatic acid (trace).
X. hypoleia contains protocetraric acid (major) and virensic acid (± traces).
X. pseudohypoleia contains fumarprotocetraric acid (major) and protocetraric acid (traces).
X. hypoprotocetrarica contains hypoprotocetraric acid (major) and rarely traces of 4-*0*-demethylnotatic acid, 4-*0*-methylhypoprotocetraric acid, *X. notata* contains notatic acid (major), 4-*0*-methylhypoprotocetraric acid (major), and rarely hypoprotocetraric acid (traces), subnotatic acid (traces), 4-*0*-demethylnotatic acid (traces), and isonotatic acid (minor).

Hence *X. hypoleia* and *X. notata* for instance could be considered to contain replacement compounds, while *X. hypoleia* and *X. pseudohypoleia* have biogenetically related compounds and belong to a depsidone-containing chemosyndrome. In fact the species with the most similar morphology (*X. pseudohypoleia* and *X. burmeisteri*) are chemically most distant. Consequently it would appear meaningless to differentiate replacement-type and chemosyndromic variations in such instances and all such chemotypes must be accorded the same taxonomic rank (Elix, 1982). Further, to encompass chemosyndromic variants a true intermediate or chemical combinant cannot be simply defined as containing both of two replacement compounds, but would have to contain both in comparable concentrations.

A further important feature of chemical races is their ecology. In several cases that have received detailed study, different chemical races are ecologically sorted into distinct habitats in their region of sympatry (W. L. Culberson, 1969*b*, 1973; W. L. Culberson & C. F. Culberson, 1967). Although the underlying physiological causes of this sorting or the factors influencing related phytogeographically significant distributions remain unknown, they do indicate that the chemical races may have a more than superficial genetic basis.

In summary, almost all chemotypes have subtle morphological, ecological, or distributional tendencies (i.e. disregarding accessory chemical variations) and consequently should be accorded some taxonomic recognition (Brodo, 1978). Consequently in this revision chemical variants of the above type are accorded recognition at the species level. Even so, most species discussed are morphologically and chemically well-defined, but in several complex groups (e.g. *X. amphixantha* group of species, *X. subnuda* group, and the *X. hypoleia* group) a number of chemical species are recognized. Some lichenologists (Galloway, 1981) disagree with such recognition but similar approaches have been adopted in taxonomic treatments of the genera *Parmotrema* (Hale, 1965) and *Neofuscelia* (Esslinger, 1977) where analogous chemical variations are encountered. Furthermore, although it has been recent practice in *Xanthoparmelia* to regard all chemically distinct taxa as species (Hale, 1971*a*; Nash, 1974*c*; Kurokawa & Filson, 1975; Krog, 1978; Elix, 1976, 1981, Elix & Armstrong, 1983; Filson, 1982; Hale, 1984) we now wish to emphasise that this criterion must be used with some caution.

A list of the Australasian species of *Xanthoparmelia* according to their diagnostic (invariant) secondary metabolites follows.

Barbatic acid
  X. barbatica, X. burmeisteri, X. centralis, X. louisii, X. vicaria, X. xerophila
Barbatic acid and norstictic acid
  X. donneri
Conorlobaridone, conloxodin, constipatic acid, loxodin, norlobaridone
  X. xanthosorediata
Constipatic acid, protoconstipatic acid
  X. globulifera, X. nebulosa, X. oleosa, X. ustulata
Constipatic acid, protoconstipatic acid, loxodin, norlobaridone
  X. constipata
Constipatic acid, protoconstipatic acid, scabrosin derivatives
  X. immutata

Diffractaic acid
X. everardensis, X. mannumensis, X. nashii, X. tucsonensis
Exuviatic acids
X. exuviata, X. spargenosa
Fumarprotocetraric acid, succinprotocetraric acid (±)
X. concomitans, X. dayiana, X. hypomelaenoides, X. iniquita, X. pertinax, X. pseudohypoleia, X. reptans, X. rogersii, X. willisii
Hypoprotocetraric acid
X. hypoprotocetrarica, X. laxencrustans, X. subdomokosii, X. weberi
Hypostictic acid, hyposalazinic acid
X. gongylodes, X. metastrigosa, X. multipartita, X. sulcifera, X. subcrustacea
Norlobaridone, loxodin (±)
X. amplexula, X. australiensis, X. dichotoma, X. dubitata, X. eilifii, X. elaeodes, X. exillima, X. filarszkyana, X. flavescentireagens, X. furcata, X. incrustata, X. metamorphosa, X. scabrosa, X. subdistorta, X. thamnoides, X. verdonii
Norstictic acid, connorstictic acid
X. alexandrensis, X. congesta, X. dissitifolia, X. filsonii, X. flindersiana, X. norconvoluta, X. norpumila, X. pseudoamphixantha, X. pustuliza, X. streimannii
Norstictic acid, salazinic acid (±)
X. arapilensis, X. barbellata, X. consociata, X. elixii, X. glareosa, X. metaclystoides, X. neotinctina, X. subnuda, X. substrigosa, X. terrestris
Notatic acid, 4-*0*-methylhypoprotocetraric acid
X. notata
Protocetraric acid
X. hypoleia, X. verruciformis
Salazinic acid
X. antleriformis, X. alternata, X. australasica, X. bellatula, X. cheelii, X. constrictans, X. convoluta, X. cordillerana, X. digitiformis, X. eradicata, X. erosa, X. examplaris, X. incerta, X. isidiigera, X. isidiosa, X. lineola, X. mexicana, X. neorimalis, X. parvoincerta, X. praegnans, X. pumila, X. taractica, X. tasmanica, X. versicolor.
Salazinic acid, skyrin
X. ferruma, X. luminosa
Scabrosin derivatives
X. bungendorensis, X. cravenii, X. remanens, X. rupestris
Stictic acid, constictic acid
X. adhaerens, X. amphixantha, X. aurifera, X. crateriformis, X. molliuscula, X. mougeotina, X. phillipsiana, X. suberadicata, X. succedans, X. tegeta.

(ii) *Accessory metabolites in Xanthoparmelia*

As the taxonomy of this genus places considerable reliance on chemical variation one must be particularly careful to distinguish those variations which are taxonomically insignificant. The occurrence of accessory metabolites is one such feature. These substances are ones which occur sporadically in a species, usually in addition to other constituents, and have no correlation with any morphological or distributional variation. Such substances commonly occur as accessory compounds in more than one species and often vary in quantity from deficiency to abundance. Accessory substances can be subdivided into two groups:

(a) those present in trace quantities which are biosynthetically closely related to the major metabolites (e.g. traces of constictic acid and cryptostictic acid present in species producing stictic acid).
(b) those present in significant quantities and which are biosynthetically distant from the diagnostic lichen substances.

It is the latter group of compounds which are most likely to cause confusion.

The most common accessory compounds detected in *Xanthoparmelia* are the aliphatic acids constipatic acid, protoconstipatic acid, dehydroconstipatic acid, and pertusaric acid. Thin-layer chromatographic behaviour of three of these compounds was first described by Kurokawa &

Filson (1975) and we recently reported on the structural elucidation of these compounds (Chester & Elix, 1979*b*). Although they occur sporadically in a number of species, these aliphatic acids appear to be far more common in specimens collected in particularly arid areas, e.g. northern and western South Australia, western New South Wales and in the Sonoran Desert (Mexico). It appears possible that such environmental conditions stimulate the biosynthesis of these compounds, and that the same species growing in more temperate areas simply produce the diagnostic depsidones.

Other accessory metabolites include lobaric acid (Krog, 1978) and the scabrosin derivatives, i.e. scabrosin 4,4′-diacetate, scabrosin 4-acetate-4′-butyrate, scabrosin 4,4′-dibutyrate, and scabrosin 4-acetate-4′-hexanoate (Begg, Elix & Jones, 1978). The presence of these accessory metabolites has yet to be correlated with any environmental factors.

As an example consider the four chemical races of *Xanthoparmelia amplexula* (all of which also contain usnic acid):

(a) containing loxodin and norlobaridone.
(b) containing loxodin, norlobaridone, constipatic, and protoconstipatic acids.
(c) containing loxodin, norlobaridone, and four scabrosin derivatives.
(d) containing loxodin, norlobaridone, constipatic acid, protoconstipatic acid, and four scabrosin derivatives.

However, these compounds are not always of an accessory nature. For instance *X. barbatica* invariably contains usnic, barbatic, 4-*0*-demethylbarbatic, 3-α-hydroxybarbatic, constipatic, and dehydroconstipatic acids, while *X. xanthosorediata* contains usnic acid, loxodin, norlobaridone, conloxodin, conorlobaridone, constipatic, and protoconstipatic acids (Begg, Chester & Elix, 1979; Chester & Elix, 1979*b*). Further, some species produce only usnic acid and the aliphatic acids or scabrosin derivatives. In a formal manner these could be considered 'acid-deficient' species containing accessory metabolites.

Species delimitation

The vast majority of species described in the present revision are clearly distinguished by two or more independent characters (e.g. the presence/absence of soredia, isidia, dactyls, lobules, or maculae, the medullary chemistry, lobe configuration, adnation of the thallus, colour of the lower surface, rhizine morphology, and geographic distribution) but a few essentially one-major character species have been included. In such cases the critical diagnostic character may be morphological and obvious (e.g. *X. aurifera* which, although much rarer, is sympatric with *X. amphixantha* and is distinguished only by production of soredia) or chemical and more subtle (e.g. *X. amphixantha* and *X. pseudoamphixantha* which maintain their chemical integrity even though they are sympatric). No doubt some critics will consider our species concept to be too narrow, but hopefully few of the morphological or chemical variants observed in the Australasian species of *Xanthoparmelia* will have been overlooked.

World distribution

Initially it appeared that southern Africa was the major centre of speciation of *Xanthoparmelia* as 30 of the 50 species then known from that area were considered endemic (Hale, 1971*a*). North America, with 29 species, and Australia, were recognized as other major centres, but Euroasia and South America were thought to have relatively poor floras. Subsequently Australasia has proved to be far richer in species than previously recognized and in the present revision 117 species are recorded, the largest group for any continent. In contrast, further work by Knox & Brusse (1983) has led to the addition of only 10 new species for southern Africa, bringing the African total to approximately 60. Additions to the North American flora (Hale, 1971*b*, 1984; Nash, 1973, 1974 *a, b, c*; Dey, 1974, Egan & Derstine, 1978; Egan, 1982, and C. F. Culberson, Nash & Johnson, 1979) have raised the total to over 40 species.

The question which then arises is whether there are three major, independent centres of speciation, or whether some species migration has occurred? The answer is not immediately apparent but what is known is the degree of species sharing. For instance, all of the 47 species known from New Zealand also occur in Australia. Thus with the *Xanthoparmeliae* there appear to be no New Zealand endemics, so in this particular genus it would appear that wind borne thalline fragments and spores could account for this high degree of sharing. South Africa and Australia are currently known to have 17 species in common, including fertile species (e.g. *X. eradicata*), isidiate species (*X. amplexula*), and those propagated by fragmentation (*X. molliuscula*). Again the prevailing westerly winds might account for the dispersal of these species, assuming that they originated in South Africa.

There appears to be some circumstantial evidence for this suggestion for representatives from most major groups of species co-occur in South Africa and Australia (see Table 4). This includes subcrustose species (*X. adhaerens, X. mougeotina*), terricolous, revolute lobed species (*X. molliuscula*), those with effigurate maculae on the upper surface (*X. hypoleia, X. hypoprotocetrarica*), emaculate linear-elongate lobed species (*X. eradicata, X. suberadicata*), the fertile broad-lobed, adnate species (*X. pertinax, X. subdomokosii*), and *X. amplexula* and *X. scabrosa* (norlobaridone-containing taxa).

These taxa could represent early colonizers of Australia from Africa and subsequent morphological elaboration and chemical evolution could have followed and made a very significant contribution to the wealth of species found in the region.

It is possible that these species could be representatives of a more ancient Gondwanaland flora. Several lichen genera, such as *Pseudocyphellaria, Sticta, Psoroma, Placopsis,* and *Menegazzia* have predominantly southern hemisphere distributions, a fact which presumably reflects a Gondwanaland origin. Such an origin cannot be proved because lichens are absent from the fossil record, but is supported by biogeographic data and chemical studies. For *Xanthoparmelia* it is premature to make precise comparisons. However, the number of taxa enumerated above are clearly consistent with a Gondwanaland origin followed by separate evolution after the separation of the continents. The obvious proliferation of species within Australia is presumably due to a favourable substrate and arid to semi-arid climate over an extended period of time.

The sharing of species between Australia and North America is more limited (a total of 11 species, Table 4) and the majority of these are hot desert plants, common to central Australia and the south-western United States and northern Mexico. Several of these species are quite

Table 4 Species of *Xanthoparmelia* shared between Australasia, Africa, and North America.

Australia & S. Africa	Australia & N. America	In three or more continents
X. adhaerens	*X. australasica*	*X. amplexula*
X. australasica	*X. barbatica*	*X. mexicana*
X. amplexula	*X. lineola*	*X. mougeotina*
X. constrictans	*X. mexicana*	*X. scabrosa*
X. eradicata	*X. mougeotina*	*X. taractica*
X. exillima	*X. neorimalis*	*X. tasmanica*
X. hypoleia	*X. oleosa*	
X. hypoprotocetrarica	*X. taractica*	
X. molliuscula	*X. tasmanica*	
X. mougeotina	*X. tucsonensis*	
X. pertinax	*X. weberi*	
X. scabrosa		
X. subdomokosii		
X. suberadicata		
X. tasmanica		
X. tegeta		
X. weberi		

rare on both continents (e.g. *X. oleosa, X. tucsonensis, X. barbatica*) and there does not appear to be a straightforward explanation of such disjunct distributions. Possibly parallel morphological and chemical evolution has occurred in similar environmental niches in the two continents.

Abbreviations

The following abbreviations are used in the keys and subsequent text; ACT (Australian Capital Territory), NSW (New South Wales), NT (Northern Territory), NZ (New Zealand), Qld (Queensland), SA (South Australia), Tas (Tasmania), Vic (Victoria), and WA (Western Australia). An exclamation mark (!) indicates that the specimen has been seen by the authors.

Artificial key to the Australasian species

Ia.	Thallus with soredia, isidia, or dactyls	Key A
Ib.	Thallus lacking soredia, isidia, or dactyls	Key B

Key A. Thallus with soredia, isidia, or dactyls

1a.	Thallus with soredia, open dactyls, or erumpent isidia	2
1b.	Thallus with isidia, isidia not bursting open at the apices	21
2a (1a).	Thallus sorediate, lacking isidia or dactyls	3
2b.	Thallus with open erumpent isidia or dactyls, ± developing soredia	6
3a (2a).	Thallus adnate on rocks, lobes plane	**116. X. xanthosorediata** (p. 357)
3b.	Thallus loose on soil, lobes convex	4
4a (3b).	Lobes convolute, broad (3–5 mm wide)	**37. X. erosa** (p. 241)
4b.	Lobes weakly convex, narrow (to 1.0 mm wide)	5
5a (4b).	Medulla K+ yellow (stictic acid-major)	**8. X. aurifera** (p. 197)
5b.	Medulla K+ brownish (fumarprotocetraric, succinprotocetraric acids)	**18. X. concomitans** (p. 210)
6a (2b).	Under surface pale	7
6b.	Under surface black	17
7a (6a).	Thallus tightly adnate, ± areolate in centre	8
7b.	Thallus moderately to loosely adnate, distinctly foliose, central lobes not areolate	13
8a (7a).	Thallus subcrustose, central lobes areolate	11
8b.	Thallus foliose, central lobes not areolate	9
9a (8b).	Medulla K+ yellow-red (norstictic, connorstictic acids)	**46. X. flindersiana** (p. 253)
9b.	Medulla K−	10
10a (9b).	Medulla KC+ yellow (barbatic acid – major)	**16. X. centralis** (p. 207)
10b.	Medulla KC− (hypoprotocetraric acid – major)	**114. X. weberi** (p. 354)
11a (8a).	Lobes narrow (0·5–1·0 mm), medulla P+ orange-red (fumarprotocetraric, succinprotocetraric acids)	**27. X. dayiana** (p. 225)
11b.	Lobes broader (0·8–3·0 mm)	12
12a(11b).	Medulla K+ yellow-red (salazinic acid)	**83. X. praegnans** (p. 308)
12b.	Medulla K− (constipatic, protoconstipatic acids)	**49. X. globulifera** (p. 257)
13a (7b).	Lobes broad (2–5 mm), ± lobulate, medulla K+ yellow-red (salazinic acid)	**24. X. cordillerana** (p. 220)
13b.	Lobes narrow (1–2 mm), elobulate, medulla K−	14
14a(13b).	Medulla KC+ rose (loxodin, norlobaridone)	15
14b.	Medulla KC− (fatty acids)	16
15a(14a).	Thallus saxicolous, lobes thin, 0·1–0·15(–0·2) mm thick	**92. X. scabrosa** (p. 321)
15b.	Thallus terricolous, lobes thick, 0·15–0·2(–0·25) mm (with additional constipatic, protoconstipatic acids)	**21. X. constipata** (p. 215)
16a(14b).	Upper cortex fragile, flaking (exuviatic acids A and B)	**41. X. exuviata** (p. 246)
16b.	Upper cortex intact, not flaking (scabrosin derivatives)	**88. X. remanens** (p. 314)

17a (6b).	Thallus loosely adnate, lobes subascending (norstictic, connorstictic acid)	**2. X. alexandrensis** (p. 186)
17b.	Thallus moderately to tightly adnate, lobes flat	18
18a(17b).	Thallus subcrustose (stictic acid – major)	**25. X. crateriformis** (p. 221)
18b.	Thallus foliose, containing other lichen acids	19
19a(18b).	Medulla K−, KC+ rose (loxodin, norlobaridone)	**110. X. verdonii** (p. 346)
19b.	Medulla K+ yellow-red, lacking norlobaridone	20
20a(19b).	Isidia dactylate, opening, closed dactyls granulate; central lobes not areolate (norstictic, connorstictic acids)	**87. X. pustuliza** (p. 313)
20b.	Isidia rarely becoming erumpent, not granulate; central lobes areolate (salazinic acid)	**59. X. isidiosa** (p. 274)
21a (1b).	Undersurface pale	22
21b.	Undersurface black	32
22a(21a).	Thallus areolate or subcrustose in centre, tightly adnate	23
22b.	Thallus lobate throughout, not areolate in centre, adnate to loosely adnate	28
23a(22a).	Medulla K+ yellow-red or yellow-pale red	24
23b.	Medulla K−	27
24a(23a).	Isidia simple, short or sparingly branched, 0·2–0·5 mm tall	25
24b.	Isidia taller becoming coralloid, usually > 1·0 mm tall	26
25a(24a).	Medulla K+ yellow-pale red, P− (hypostictic and hyposalazinic acids)	**50. X. gongylodes** (p. 258)
25b.	Medulla K+ yellow-deep red, P+ yellow (salazinic and norstictic acids)	**20. X. consociata** (p. 214)
26a(24b).	Lobes 0·3–1·0 mm wide (salazinic acid)	**6. X. antleriformis** (p. 194)
26b.	Lobes 0·5–2·0 mm wide (norstictic, connorstictic acids)	**94. X. streimannii** (p. 324)
27a(23b).	Medulla KC+ rose (norlobaridone)	**40. X. exillima** (p. 245)
27b.	Medulla KC− (constipatic acid, scabrosins)	**54. X. immutata** (p. 266)
28a(22b).	Medulla K+	29
28b.	Medulla K−, KC+ rose (norlobaridone)	**5. X. amplexula** (p. 192)
29a(28a).	Medulla K+ yellow, lobes elongate (2–4 mm) (stictic, norstictic, constictic acids)	**101. X. succedans** (p. 333)
29b.	Medulla K+ yellow-red, lobes irregular (less than 2 mm long)	30
30a(29b).	Isidia simple or sparingly branched, scattered; medulla K+ yellow-pale red (hypostictic, hyposalazinic acids)	**50. X. gongylodes** (p. 258)
30b.	Isidia dense, becoming coralloid; medulla K+ yellow-deep red (salazinic acid)	31
31a(30b).	Lobes broad, 1·5–3·0 mm wide, apices rotund	**68. X. mexicana** (p. 288)
31b.	Lobes narrow, 0·3–1·0 mm wide, apices narrow	**6. X. antleriformis** (p. 194)
32a(21b).	Thallus tightly adnate, lobes less than 1.0 mm wide	33
32b.	Thallus adnate to loosely adnate, lobes more than 1.0 mm wide	36
33a(32a).	Thallus K+ yellow or yellow-red (stictic or norstictic acids)	34
33b.	Thallus K−, KC+ yellow (barbatic, 4-*O*-demethylbarbatic acids)	**117. X. xerophila** (p. 358)
34a(33a).	Medulla K+ yellow or yellow-pale red (stictic acid – major)	35
34b.	Medulla K+ yellow-deep red (norstictic acid, connorstictic acid)	**44. X. filsonii** (p. 251)
35a(34a)	Lobes linear-elongate (greater than 2 mm), thin, flat; widespread	**70. X. mougeotina** (p. 290)
35b.	Lobes short (1–2 mm long), thick, convex; Macquarie Is, Tas.	**82. X. phillipsiana** (p. 307)
36a(32b).	Medulla K+ yellow-red	39
36b.	Medulla K−	37
37a(36b).	Medulla KC− (diffractaic acid – major)	**72. X. nashii** (p. 293)
37b.	Medulla KC+ rose or yellow	38
38a(37b).	Medulla KC+ rose (loxodin, norlobaridone)	**107. X. thamnoides** (p. 342)
38b.	Medulla KC+ yellow (barbatic acid – major)	**113. X. vicaria** (p. 352)
39a(36a).	Isidia sparse to moderate, subglobose, or slender cylindrical (salazinic acid)	**58. X. isidiigera** (p. 272)

39b. Isidia dense, becoming coralloid branched and ± forming an isidiose mat 40

40a(39b). Thallus loosely adnate, lobes broad (2–4 mm), irregular (salazinic acid) **9. X. australasica** (p. 198)

40b. Thallus adnate, lobes narrower (1–2·5 mm), sublinear-elongate (norstictic acid) **75. X. neotinctina** (p. 297)

Key B. Thallus lacking soredia, isidia, and dactyls

1a. Lobes convolute, revolute, or with a canaliculate lower surface (at least in part); usually terricolous 2

1b. Lobes ± flat, lower surface not canaliculate; generally saxicolous 24

2a (1a). Thallus lobulate 3

2b. Thallus lacking lobules 10

3a (2a). Undersurface pale brown to tan 4

3b. Undersurface dark brown to black 7

4a (3a). Medulla K−, KC+ rose (loxodin, norlobaridone) .... **33. X. eilifii** (p. 235)

4b. Medulla K+ yellow or yellow-red 5

5a (4b). Medulla K+ yellow-red 6

5b. Medulla K+ yellow (stictic, constictic acids) .... **69. X. molliuscula** (p. 289)

6a (5a) Thallus forming subpulvinate clumps (norstictic acid – major) .... **106. X. terrestris** (p. 341)

6b. Thallus flat on substrate (salazinic acid) .... **3. X. alternata** (p. 188)

7a (3b). Thallus loosely adnate, lobes 1–3 mm wide, lobules flat or revolute 8

7b. Thallus adnate, lobes 0·8–1·5 mm wide, lobules subterete 9

8a (7a). Lobes congested, underside dark brown-black, medulla K+ (salazinic acid) **112. X. versicolor** (p. 349)

8b. Lobes separate, underside pale brown to dark brown, medulla K−, KC+ rose (loxodin, norlobaridone) .... **33. X. eilifii** (p. 235)

9a (7b). Medulla K+ yellow-dark red (salazinic acid) .... **86. X. pumila** (p. 312)

9b. Medulla K+ yellow-red-brown (norstictic, connorstictic acid) .... **77. X. norpumila** (p. 300)

10a (2b) Lobes distinctly convolute or revolute, terete in part 11

10b. Lobes ± convex, lower surface canaliculate in part 14

11a(10a). Medulla K+ yellow-deep reddish 12

11b. Medulla K−, KC+ rose (loxodin, norlobaridone) 13

12a(11a). From eastern S.A. (salazinic acid) .... **23. X. convoluta** (p. 219)

12b. From Nullarbor or Murray mallee (norstictic acid) .... **76. X. norconvoluta** (p. 299)

13a(11b). Lobes convolute, 1–3 mm wide, loose on substrate .... **10. X. australiensis** (p. 199)

13b. Lobes revolute, 0·3–1·0 mm wide, adnate to substrate .... **96. X. subdistorta** (p. 326)

14a(10b). Thallus adnate on rocks 15

14b. Thallus loosely adnate on soil 16

15a(14a). Medulla K+ yellow-red (salazinic acid) .... **39. X. examplaris** (p. 243)

15b. Medulla K−, KC+ rose (norlobaridone) .... **56. X. incrustata** (p. 269)

16a(14b). Medulla K+ yellow or yellow-red 17

16b. Medulla K− 21

17a(16a). Upper surface of marginal lobes emaculate 18

17b. Upper surface of marginal lobes maculate 20

18a(17a). Medulla K+ yellow or yellow-pale red; lobes entangled (hypostictic, hyposalazinic acids) .... **102. X. sulcifera** (p. 335)

18b. Medulla K+ yellow-deep red 19

19a(18b). Lobes forming rosettes (salazinic acid) .... **13. X. bellatula** (p. 203)

19b. Lobes entangled (norstictic acid – major) .... **106. X. terrestris** (p. 341)

20a(17b). Medulla K+ yellow (stictic, constictic acids) .... **4. X. amphixantha** (p. 190)

20b. Medulla K+ yellow-red (norstictic, connorstictic acids) **84. X. pseudoamphixantha** (p. 309)

21a(16b). Upper surface emaculate, medulla P−, KC+ rose (loxodin, norlobaridone) 22

21b. Upper surface maculate, P+ orange-red (fumarprotocetraric, and ± succinprotocetraric acids) 23

22a(21a). Lobes revolute, dichotomously divided .... **33. X. eilifii** (p. 235)
22b. Lobes irregularly convex but not revolute, subirregularly divided **45. X. flavescentireagens** (p. 252)

23a(21b). Lobes regularly dichotomously divided, moderately rhizinate .... **89. X. reptans** (p. 316)
23b. Lobes irregularly branched, very sparsely rhizinate .... **115. X. willisii** (p. 355)

24a (1b). Upper cortex maculate 25
24b. Upper cortex lacking maculae 33

25a(24a). Lower surface brown to ivory 26
25b. Lower surface black 28

26a(25a). Lobes narrow (less than 1 mm), linear-elongate, medulla K−, KC+ rose (loxodin, norlobaridone) .... **66. X. metamorphosa** (p. 285)
26b. Lobes broad (greater than 1·5 mm), irregular, medulla K+ deep red (norstictic, salazinic acid) 27

27a(26b). Lower surface brown to dark-brown, rhizines black-brown, dichotomous **100. X. substrigosa** (p. 331)
27b. Lower surface pale ivory to tan, rhizines pale, simple .... **7. X. arapilensis** (p. 195)

28a(25b). Medulla P+ orange 29
28b. Medulla P− 30

29a(28a). Thallus adnate (protocetraric acid) .... **51. X. hypoleia** (p. 260)
29b. Thallus loosely adnate (fumarprotocetraric acid) .... **85. X. pseudohypoleia** (p. 311)

30a(28b). Medulla KC+ yellow (barbatic acid – major) .... **15. X. burmeisteri** (p. 206)
30b. Medulla KC− 31

31a(30b). Lobes subascending at apices (hypoprotocetraric acid) .... **53. X. hypoprotocetrarica** (p. 265)
31b. Lobes flat 32

32a(31b). Lobes linear-elongate, di- or trichotomously divided (diffractaic acid – major) **64. X. mannumensis** (p. 283)
32b. Lobes short, irregular or subdichotomously divided (notatic, 4-*0*-methylhypoprotocetraric acids) .... **78. X. notata** (p. 301)

33a(24b). Lobes dichotomously divided, linear-elongate, separate 34
33b. Lobes irregularly divided, contiguous at least in part 48

34a(33a). Lower surface pale ivory to tan 35
34b. Lower surface black or brown-black 39

35a(34a). Medulla K+ yellow-red (salazinic and/or norstictic acid) 36
35b. Medulla K−, KC+ rose (loxodin, norlobaridone) 37

36a(35a). Lobes subascending at apices (norstictic and salazinic acids) .... **35. X. elixii** (p. 237)
36b. Lobes more or less flat throughout (salazinic acid) .... **29. X. digitiformis** (p. 227)

37a(35b). Lobes narrow (less than 0·8 mm), upper surface sparingly maculate **66. X. metamorphosa** (p. 285)
37b. Lobes broader (0·8–2·5 mm), upper surface emaculate 38

38a(37b). Lower surface pale ivory, moderately rhizinate; lobes subdichotomously divided **45. X. flavescentireagens** (p. 252)
38b. Lower surface brown, sparsely rhizinate; lobes dichotmously divided **47. X. furcata** (p. 254)

39a(34b). Medulla P+ yellow or yellow-orange 40
39b. Medulla P− 46

40a(39a). Medulla K+ yellow (stictic, constictic acids) 41
40b. Medulla K+ yellow-deep red (norstictic and/or salazinic acid) 42

41a(40a). Lobes irregularly constricted, rhizines moderate, slender, elongated **105. X. tegeta** (p. 339)
41b. Lobes not constricted, rhizines sparse, short, robust .... **98. X. suberadicata** (p. 329)

42a(40b). Lobes densely imbricate forming a thick mat, flat, lower surface ± smooth 43
42b. Lobes ± imbricate but not mat forming, often subascending at the apices, lower surface distinctly wrinkled 44

43a(42a). Rhizines sparse or absent, simple (salazinic acid) .... **17. X. cheelii** (p. 208)

43b. Rhizines moderate, often dichotomously branched (norstictic, salazinic, connorstictic acids) **48. X. glareosa** (p. 256)

44a(42b). Widespread in drier area (NZ, NSW–WA) (norstictic, connorstictic, salazinic (±) acids) **99. X. subnuda** (p. 330)
44b. Restricted to cooler areas (VIC, NSW, ACT) (salazinic acid) 45

45a(44b). Rhizines moderate to dense subapically, elongate; lobes ± irregularly constricted **22. X. constrictans** (p. 217)
45b. Rhizines sparse or absent, short; lobes not constricted **36. X. eradicata** (p. 239)

46a(39b). Medulla K− 47
46b. Medulla K+ yellow-pale red (hypostictic, hyposalazinic acids) **71. X. multipartita** (p. 292)

47a(46a). Medulla KC+ rose (loxodin, norlobaridone) **28. X. dichotoma** (p. 226)
47b. Medulla KC− (scabrosins) **91. X. rupestris** (p. 319)

48a(33b). Thallus tightly adnate to subcrustose 49
48b. Thallus loosely adnate to moderately adnate 75

49a(48a). Thallus subcrustose or small-foliose, lobes narrow (less than 1·0 mm), ± aerolate in centre 50
49b. Thallus distinctly foliose, lobes broad (greater than 1·0 mm) 61

50a(49a). Lower surface black 51
50b. Lower surface pale tan to brown 55

51a(50a). Medulla K+ yellow or yellow-red 52
51b. Medulla K−, KC+ yellow (barbatic acid – major) **62. X. louisii** (p. 279)

52a(51a). Medulla K+ yellow, lobes tightly adnate (stictic acid) **1. X. adhaerens** (p. 184)
52b. Medulla K+ yellow-red, lobes adnate 53

53a(52b). Lobes 0·3–0·7 mm wide (norstictic, connorstictic acids) 54
53b. Lobes 0·5–1·0 mm wide (salazinic acid) **80. X. parvoincerta** (p. 304)

54a(53a). Lobes short (less than 1 mm), contiguous, medulla containing additional barbatic acid **31. X. donneri** (p. 231)
54b. Lobes elongate (>2 mm), separated, lacking barbatic acid **30. X. dissitifolia** (p. 228)

55a(50b). Medulla K+ yellow-red or yellow-brown 56
55b. Medulla K− 58

56a(55a). Medulla K+ yellow-brown, P+ brick red (fumarprotocetraric, succinprotocetraric acids) **81. X. pertinax** (p. 306)
56b. Medulla K+ yellow-red, P± 57

57a(56b). Medulla K+ yellow-pale red (hypostictic, hyposalazinic acids) **95. X. subcrustacea** (p. 325)
57b. Medulla K+ yellow-deep red (salazinic acid) **74. X. neorimalis** (p. 296)

58a(55b). Medulla KC+ rose (norlobaridone) **32. X. dubitata** (p. 233)
58b. Medulla KC−, norlobaridone absent 59

59a(58b). Marginal lobes short (less than 2 mm), irregular (hypoprotocetraric acid) **60. X. laxencrustans** (p. 275)
59b. Marginal lobes sublinear-elongate (greater than 2 mm) 60

60a(59b). Medulla containing constipatic, dehydroconstipatic acids **79. X. oleosa** (p. 303)
60b. Medulla containing scabrosins, ± traces constipatic, protoconstipatic acids **26. X. cravenii** (p. 223)

61a(49b). Lower surface black 62
61b. Lower surface pale ivory to brown 65

62a(61a). Medulla P+ orange-red 63
62b. Medulla P− 64

63a(62a). Medulla K+ yellow-red (salazinic acid) **55. X. incerta** (p. 268)
63b. Medulla K+ brownish (fumarprotocetraric, succinprotocetraric acids) **52. X. hypomelaenoides** (p. 263)

64a(62b). Medulla KC+ rose (loxodin, norlobaridone) **34. X. elaeodes** (p. 236)
64b. Medulla KC− (diffractaic acid – major) **38. X. everardensis** (p. 242)

65a(61b).	Lower medulla containing yellow-orange pigment (skyrin), salazinic acid – major)	**42. X. ferruma** (p. 247)
65b.	Lower medulla not pigmented	66
66a.(65b).	Medulla K+ yellow or yellow-red	67
66b.	Medulla K−	69
67a(66a).	Medulla K+ yellow or yellow-pale red (hypostictic, hyposalazinic acids)	**95. X. subcrustacea** (p. 325)
67b.	Medulla K+ yellow-deep red	68
68a(67b).	Lobes sublinear-elongate (salazinic acid)	**61. X. lineola** (p. 277)
68b.	Lobes irregular (norstictic acid – major)	**65. X. metaclystoides** (p. 284)
69a(66b).	Medulla P+ red-orange	70
69b.	Medulla P−	71
70a(69a).	Medulla containing fumarprotocetraric, succinprotocetraric acids	**81. X. pertinax** (p. 306)
70b.	Medulla containing protocetraric acid	**111. X. verruciformis** (p. 348)
71a(69b).	Medulla KC+ rose or yellow	72
71b.	Medulla KC−	73
72a(71a).	Medulla KC+ yellow (barbatic acid – major)	**11. X. barbatica** (p. 200)
72b.	Medulla KC+ rose (norlobaridone)	**43. X. filarszkyana** (p. 249)
73a(71b).	Lobes irregular (diffractaic acid – major)	**108. X. tucsonensis** (p. 343)
73b.	Lobes sublinear-elongate	74
74a(73b).	Medulla containing constipatic, dehydroconstipatic (±) acids	**109. X. ustulata** (p. 344)
74b.	Medulla containing hypoprotocetraric acid	**97. X. subdomokosii** (p. 328)
75a(48b).	Lower surface black	76
75b.	Lower surface pale ivory to brown	81
76a(75a).	Lower medulla containing yellow-orange pigment (skyrin) and salazinic acid	**63. X. luminosa** (p. 281)
76b.	Lower medulla not pigmented	77
77a(76b).	Medulla K+ intense yellow or yellow-deep red	78
77b.	Medulla K+ pale yellow-brown (fumarprotocetraric, succinprotocetraric acids)	**90. X. rogersii** (p. 317)
78a(77a).	Thallus containing salazinic acid (major)	**104. X. tasmanica** (p. 337)
78b.	Thallus containing norstictic or stictic acids (major)	79
79a(78b).	Lobes narrow (0·8–1·0 mm) (stictic acid)	**105. X. tegeta** (p. 339)
79b.	Lobes broad (1·0–2·5 mm) (norstictic acid – major)	80
80a(79b).	Lower surface moderately rhizinate, rhizines dichotomous	**48. X. glareosa** (p. 256)
80b.	Lower surface sparsely rhizinate, rhizines simple	**19. X. congesta** (p. 212)
81a(75b).	Lower medulla containing yellow-orange pigment (skyrin) (norstictic acid – major)	**12. X. barbellata** (p. 202)
81b.	Lower medulla not pigmented	82
82a(81b).	Medulla P+ yellow-orange	83
82b.	Medulla P−	88
83a(82a).	Lobes broad (2–6 mm); lower surface densely rhizinate, especially towards margin	84
83b.	Lobes narrow (1–2·5 mm); lower surface sparsely rhizinate	87
84a(83a).	Medulla K+ brownish (fumarprotocetraric, succinprotocetraric acids)	**57. X. iniquita** (p. 270)
84b.	Medulla K+ yellow-deep red (salazinic and/or norstictic acids)	85
85a(84b).	Lower surface brown to dark-brown, rhizines dichotomous (norstictic acid – major)	**100. X. substrigosa** (p. 331)
85b.	Lower surface pale ivory to tan, rhizines simple	86
86a(85b).	Lobes 3–8 mm wide, scarcely imbricate (norstictic acid – major)	**7. X. arapilensis** (p. 195)
86b.	Lobes 2–4 mm wide, highly imbricate (salazinic acid)	**103. X. taractica** (p. 336)
87a(83b).	Lobes subascending at apices (norstictic acid – major, salazinic acid)	**35. X. elixii** (p. 237)

87b. Lobes ± flat throughout (salazinic acid) .... **29. X. digitiformis** (p. 227)

88a(82b). Lower surface densely rhizinate, rhizines dichotomous (hypostictic, hyposalazinic acids) .... **67. X. metastrigosa** (p. 287)

88b. Lower surface moderately to sparsely rhizinate, rhizines simple 89

89a(88b). Medulla KC+ rose; secondary lobes sublinear-elongate, dichotomous (loxodin, norlobaridone) .... **45. X. flavescentireagens** (p. 252)

89b. Medulla KC−, secondary lobes irregular 90

90a(89b). Lobes moderately adnate 91

90b. Lobes loosely adnate 92

91a(90a). Lobes 0·7–1·5 mm wide (constipatic, protoconstipatic acids) .... **109. X. ustulata** (p. 344)

91b. Lobes 1·0–2·5 mm wide (exuviatic acids A, B) .... **93. X. spargenosa** (p. 322)

92a(90b). Secondary lobes loosely imbricate (scabrosins) .... **14. X. bungendorensis** (p. 205)

92b. Secondary lobes densely imbricate (usnic acid and ± traces of aliphatic acids) **73. X. nebulosa** (p. 295)

Species

1. Xanthoparmelia adhaerens (Nyl.) Hale

in *Phytologia* **28**: 486 (1974).

≡ *Parmelia adhaerens* Nyl. in Crombie in *J. Bot. Lond.* **14**: 19 (1876). Type: South Africa, Cape of Good Hope, Table Mountain, on quartzite rocks, September 1874, *A. E. Eaton* (BM! holotype, BM! isotypes).

Illustration: Fig. 1.

DESCRIPTION. *Thallus* subcrustose, very tightly adnate to rocks, yellow-green to yellow-brown, darkening to deep olive-brown or blackish in older lobes near centre of thallus, 2–4 cm diam.; *lobes* placodiform, ± contiguous near periphery, flattened at the apices, narrow, 0·5–0·8 mm wide, becoming cracked and often forming convex areolae ca. 0·5 mm diameter in centre of thallus. *Upper surface* opaque, emaculate, lacking soredia and isidia but developing tangential cracks in older lobes. *Lower surface* black, densely rhizinate, rhizines very short, papillate or else lower surface adhearing directly to the substrate. *Apothecia* markedly innate at first, 0·5–0·7 mm in diam., margins continuous, disc brown to black; spores 9–11 × 5–7 μm.

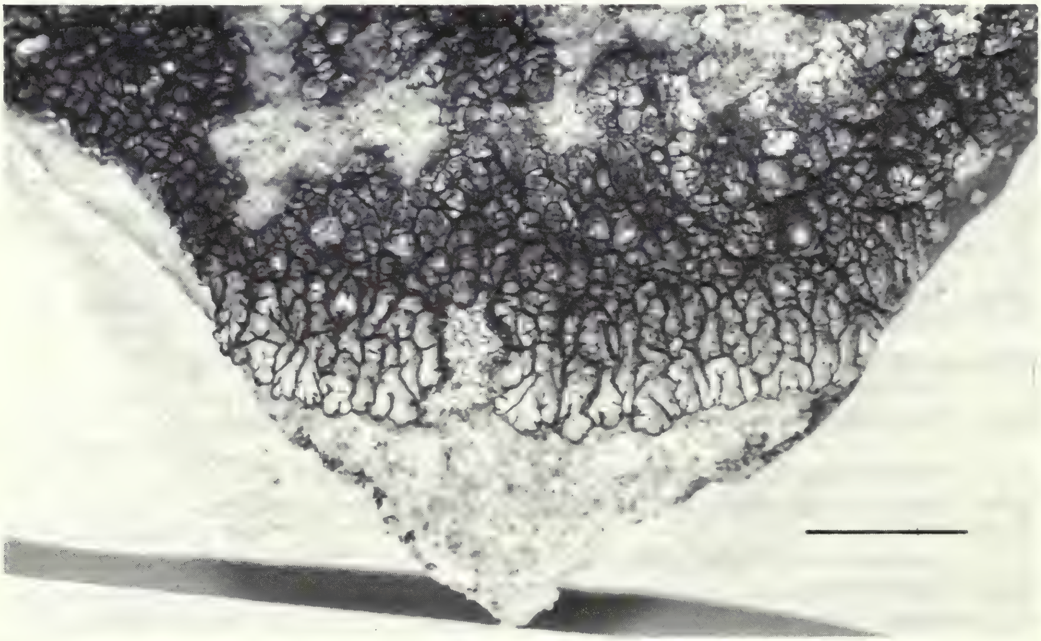
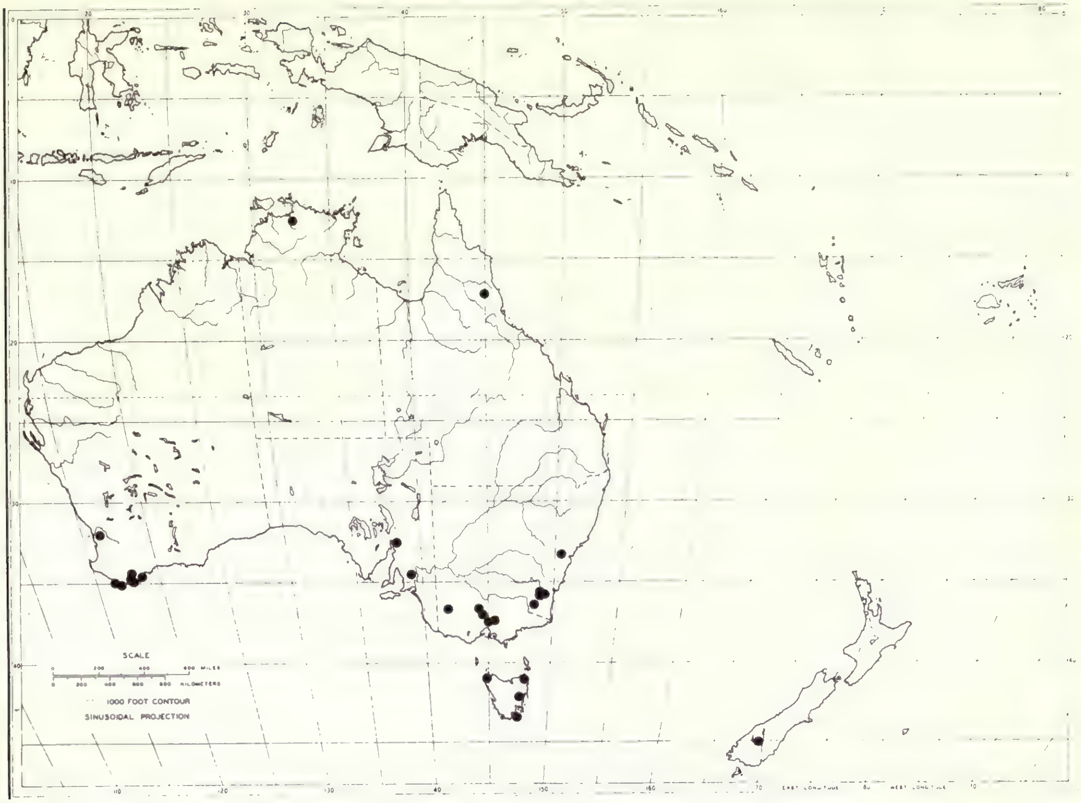


Fig. 1 *Xanthoparmelia adhaerens* (Nyl.) Hale. Isotype in BM. Scale = 0·5 cm.



Map 1 Distribution of *Xanthoparmelia adhaerens* in Australia and New Zealand.

Chemistry. Thallus K−; medulla K+ yellow, C−, P+ yellow; containing usnic acid, stictic acid (major), constictic acid, cryptostictic acid, norstictic acid (±), hypoconstictic acid (±) and hypostictic acid (±).

Distribution. Scattered in Australia (all states, ACT, NT) and South Island, New Zealand (Central Otago). Map 1. Also in South Africa. Rare on rocks from alpine to subarid areas. Specimens examined: 34.

Notes. *X. adhaerens* is characterised by the crustose to subcrustose thallus with the black lower cortex firmly attached to the substrate, either directly so or by very dense vestigial rhizines. The thallus often forms convex areolae in the older, darkened central area, but lacks isidia.

Superficially this taxon resembles a group of species related to *Xanthoparmelia dubitata* (*X. cravenii, X. neorimalis, X. oleosa,* and *X. subcrustacea*), but these all have a pale lower surface and differ chemically. Although *X. dissitifolia* has a black lower surface like *X. adhaerens* and narrow, minute, tightly adnate lobes, the thalli are stellate and the lobes linear-elongate rather than being continuous and areolate. Further *X. dissitifolia* contains norstictic acid and connorstictic acid rather than the stictic acid complex.

Morphologically *X. adhaerens* is very similar to *Xanthoparmelia louisii* and *X. donneri*, but the latter species are distinguished chemically by the production of barbatic acid and 4-*0*-demethylbarbatic acid in the medulla. Further, *X. adhaerens* is more widely distributed in Australia (and South Africa) than the other two species. *X. donneri* occurs in Eyre Peninsula (SA) and southwestern WA, while *X. louisii* appears to be restricted to south-western Western Australia. These distinctive distribution patterns coupled with the absence of chemical combinants attests to the species status of these taxa (Elix, 1982).

X. adhaerens is uncommon on dry alpine and subalpine rocks. Associates include *Xanthopar-*

melia mougeotina, X. congesta, X. tegeta, Lecidea aspidula Krempelh., *Caloplaca fulgens* Koerb. and *Umbilicaria species.*

2. Xanthoparmelia alexandrensis Elix & Jen Johnston, sp. nov.

Thallus ut in *Xanthoparmelia subnuda* sed superficie superiore isidiata, isidiis globosis demum ad apicorum inflatibus, apicibus saepe erumpentibus differt. Thallus 220–255 μm crassus; cortex superior 20–30 μm crassus, stratum gonidiale 15–45 μm crassum, medulla 90–140 μm crassa, cortex inferior 10–20 μm crassus.

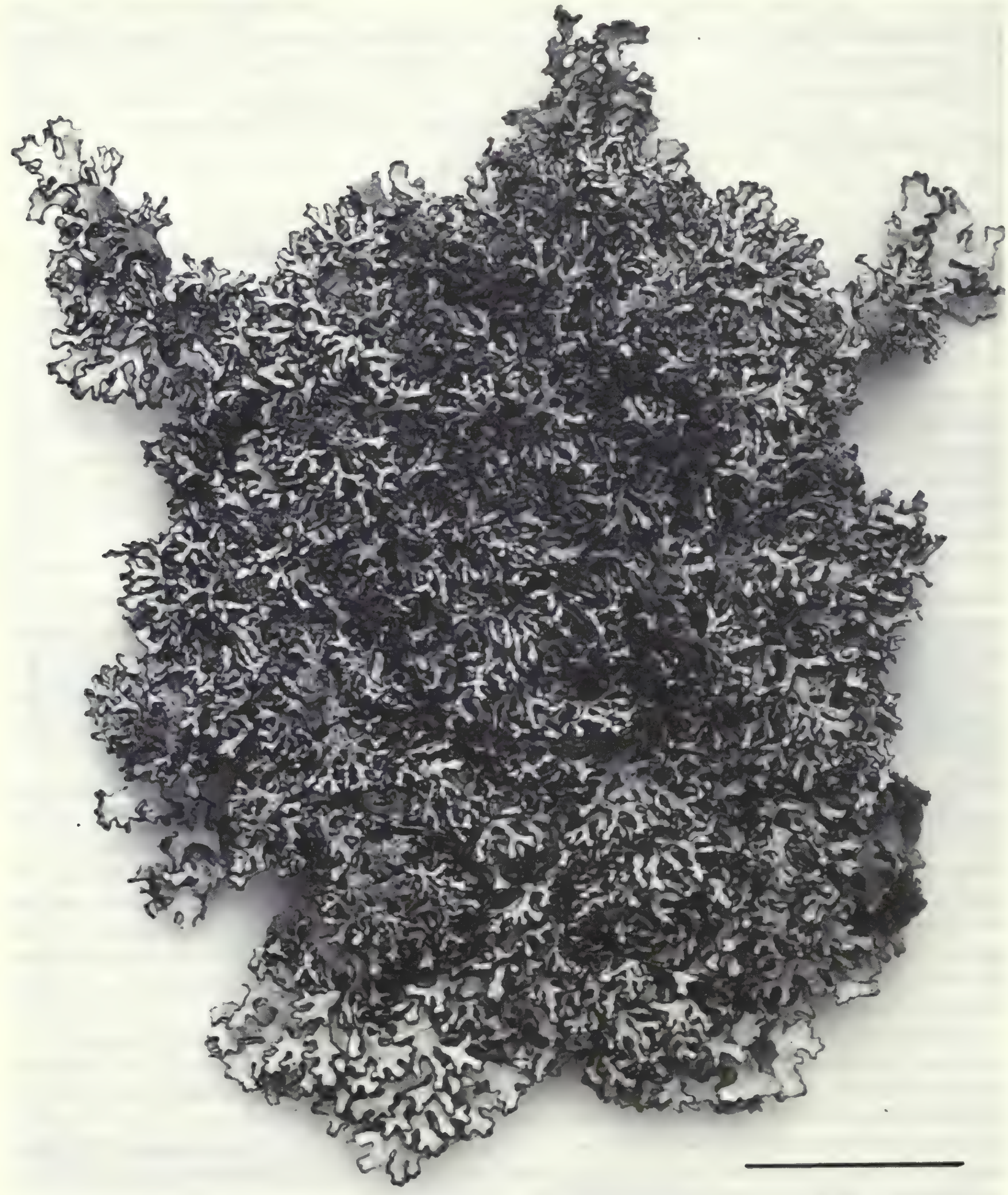


Fig. 2 *Xanthoparmelia alexandrensis* Elix & Jen Johnston. Holotype in CHR. Scale = 1 cm.

Thallus K−; medulla K+ primum flavens deinde rubescens, C−, P+ intense lutescens; acidum usnicum, acidum norsticticum et acidum connorsticticum continens.

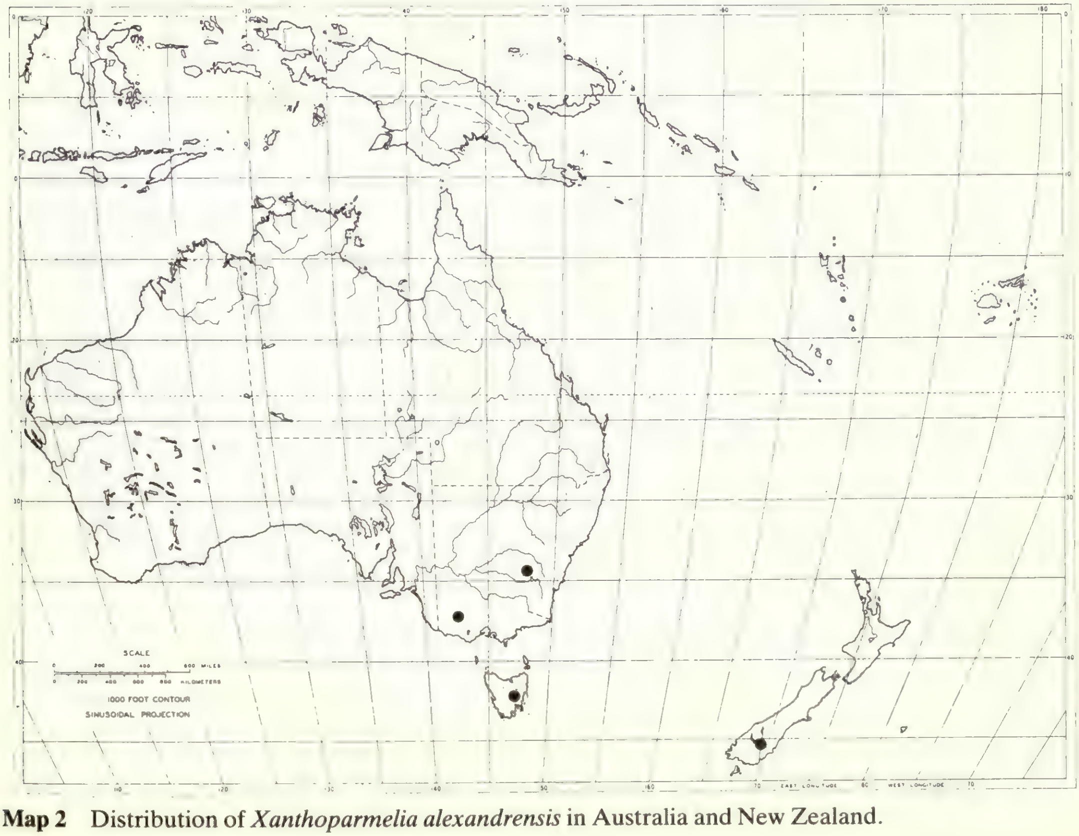
Type: New Zealand, Otago, Alexandra, Tucker Hill, on rocks in dry pasture land, 295 m, 6 January 1982, *J. A. Elix* 9900 (CHR! – holotype).
Illustration: Fig. 2.

Description. *Thallus* foliose, loosely adnate on rocks, yellow-green, *c.* 5 cm diam.; *lobes* sublinear-elongate, irregularly dichotomously or digitately branched, highly but loosely imbricate, narrow, 0·3–1·0 (1·5) mm wide, marginal lobes slightly broader, often subascending at apices of secondary lobes. *Upper surface* smooth, glossy, emaculate, blackened at margins and apices, isidiate, *isidia* scattered, simple than gnarled and sparingly branched, becoming inflated at apices and erupting but not at all sorediose; medulla white. *Lower surface* black, dull, rugose, sparsely rhizinate, rhizines simple, black, robust. *Apothecia* not seen.

Chemistry. Thallus K−; medulla K+ yellow then red, C−, P+ intense yellow; containing usnic acid, norstictic acid, connorstictic acid, and salazinic acid (± traces).

Distribution. New Zealand, South Island (Central Otago) and south-eastern Australia (NSW, Vic, Tas). Map 2. On rocks in dry subalpine areas. Specimens examined: 5.

Notes. This distinctive species is characterised by the loosely adnate thallus, the narrow, sublinear-elongate lobes with a black lower surface, and the production of erumpent isidia. Thus *X. alexandrensis* would appear to be the isidiate morph of *Xanthoparmelia subnuda*, as these two species have similar morphology and chemistry. Chemically *X. alexandrensis* is identical with *Xanthoparmelia pustuliza*, another species with erumpent propagules and a jet black lower surface. However, *X. pustuliza* is distinguished by being very tightly adnate to rocks, with



Map 2 Distribution of *Xanthoparmelia alexandrensis* in Australia and New Zealand.

somewhat broader (1·0–2·0 mm) and more irregular lobes. Further, the apices of the closed dactyls appear granulate in *X. pustuliza* but are smooth in the isidia of *X. alexandrensis*.

This species occurs with *X. glareosa, X. metaclystoides,* and *X. substrigosa*.

3. **Xanthoparmelia alternata** Elix & Jen Johnston, **sp. nov.**

Thallus ut in *Xanthoparmelia versicolor* sed superficie interiore pallido brunnea vel brunnea differt. Thallus 150–175 μm crassus; cortex superior 20–35 μm crassus, stratum gonidiale 14–20 μm crassum, medulla 110–140 μm crassa, cortex inferior *ca.* 7 μm crassus. Thallus K−; medulla K+ primo flavens deinde rubescens, C−, P+ intense lutescens; thallus acidum usnicum et acidum salazinicum et acidum consalazinicum continens.

Type: Australia, Western Australia, Dedari, 120 km from Kambalda, west of Bullabilling, past 319 mile peg at the site of pumping station, on soil, 24 April 1973, *N. Sammy* UWA 1508 (UWA! – holotype).

Illustration: Fig. 3.

DESCRIPTION. *Thallus* foliose, loosely adnate on soil or debris, yellow to pale yellow-green, darkening to olive-green with age, 3–5 cm diam., *lobes* sublinear-elongate, subdichotomously to subirregularly branched, primary lobes 1·0–2·0 mm wide; secondary lobes narrower, 0·3–1·5 mm wide, often growing over primary lobes, or occasionally ascending, coralloid, isidia-like, growing out from lobules in centre of thallus. *Upper surface* smooth at the marginal lobes, older portions becoming rugulose and cracked, convex, opaque, emaculate, lacking soredia and

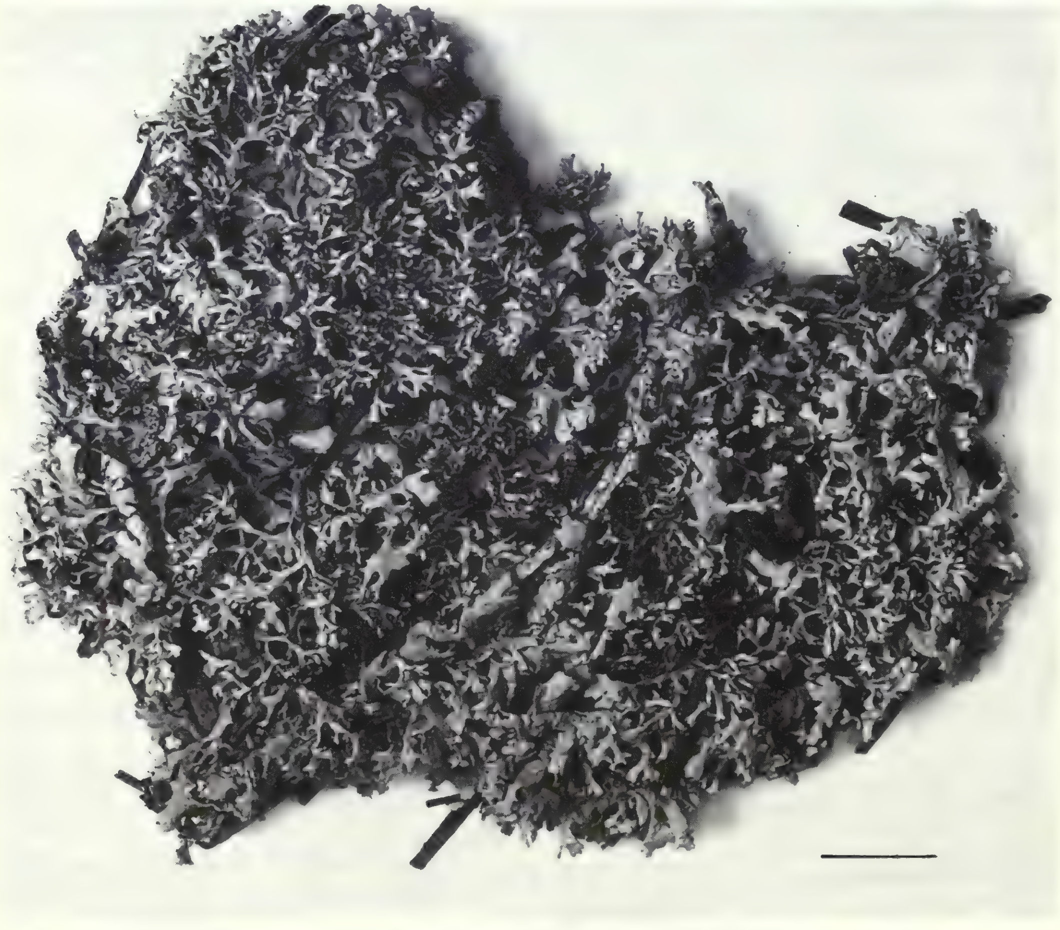


Fig. 3 *Xanthoparmelia alternata* Elix & Jen Johnston. Holotype in UWA. Scale = 1 cm.

isidia; medulla white. *Lower surface* (±) canaliculate, brown to pale tan, moderately rhizinate, rhizines concolorous with lower surface or darkening, simple, slender, ± elongate. *Apothecia* not seen.

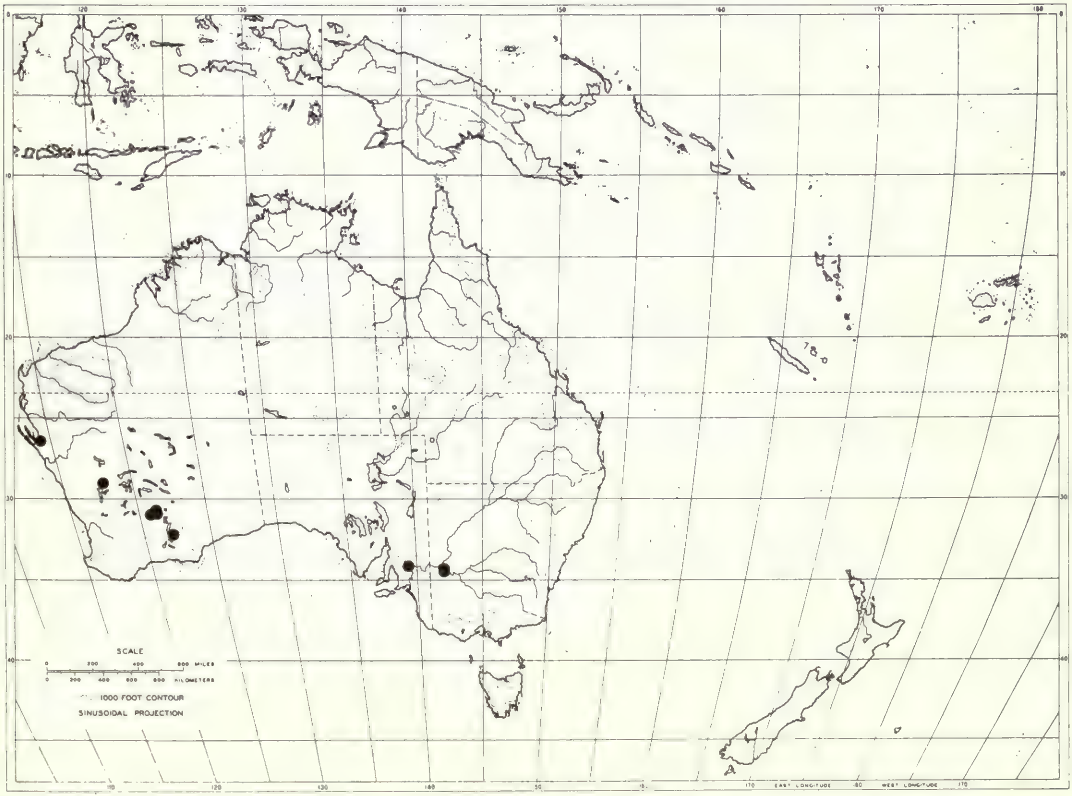
CHEMISTRY. Cortex K−; medulla K+ yellow becoming red, C−, P+ intense yellow-orange; containing usnic acid, salazinic acid, consalazinic acid, and traces of norstictic acid (±), protocetraric acid (±).

DISTRIBUTION. Inland NSW, Vic, SA, WA. Map 3. On soil in arid shrubland. Specimens examined: 10.

NOTES. This lichen is a dry soil-inhabiting species characterised by convex lobes, revolute secondary lobes or lobules in the centre of the thallus, and a pale lower surface.

Three other species show a similar combination of characters viz., *X. eilifii, X. molliuscula,* and *X. terrestris*. However, *X. eilifii* is clearly distinguished chemically (KC+ rose, P−) as the other three species are P+ yellow or orange. *X. alternata* differs from *X. molliuscula* and *X. terrestris* in both growth form and chemistry. The latter species tends to form subpulvinate clumps on soil, and have terete or subterete lobuli, while *X. alternata* grows ± flat on soil and has flat to revolute lobules. Even so *X. alternata* occasionally does assume a subpulvinate growth form, especially when growing over debris on soil. *X. alternata* contains salazinic acid as the major medullary metabolite, while *X. molliuscula* contains stictic acid and constictic acid, and *X. terrestris* norstictic acid (major) with minor quantities of connorstictic acid and salazinic acid. These species belong to the *X. versicolor* group and a key is given under *X. versicolor*.

This species resembles the South African *Xanthoparmelia amphixanthoides* (Steiner & Zahlbr.) Hale, both chemically and morphologically. However, *X. alternata* lacks the chalybaeizans unknown invariably present in the African species, and differs in the growth form of the



Map 3 Distribution of *Xanthoparmelia alternata* in Australia.

thallus and morphology of the lobules. Lobules of *X. alternata* are less markedly convex and are often flattened, erhizinate, erect, and lack differentiation between upper and lower cortices. In *X. amphixanthoides* lobules are more markedly convex and corniculate, rhizinate, dorsiventral, and with distinct upper and lower cortices.

X. alternata is a relatively rare species in Australia, occurring on soil in subarid to arid areas together with *Psora decipiens* (Hedwig) Hoffm., *Diploschistes scruposus* (Schreber) Norman, *X. versicolor, X. molliuscula, X. eilifii,* and *X. reptans*.

4. **Xanthoparmelia amphixantha** (Müll. Arg.) Hale

in *Phytologia* **28**: 486 (1974).

≡ *Parmelia amphixantha* Müll. Arg. in *Flora, Jena* **71**: 139 (1888). Type: Australia, Victoria, near Lake Albacutya, *C. French* (G! – holotype).

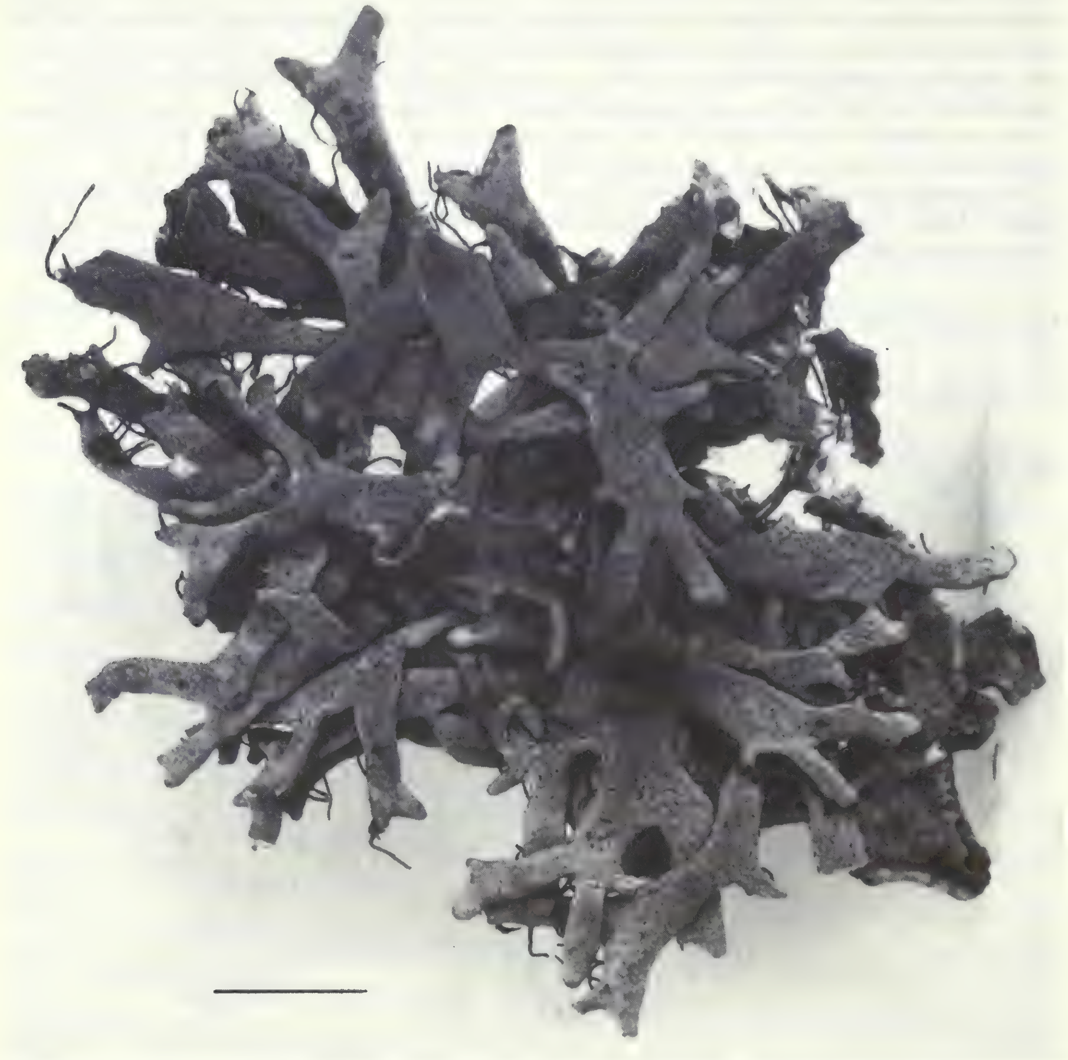


Fig. 4 *Xanthoparmelia amphixantha* (Müll. Arg.) Hale. Holotype of *Parmelia subamphixantha* in BP. Scale = 0·5 cm.

= *Parmelia subamphixantha* Gyelnik in *Ann. Mycol.* **36**: 290 (1938). Type: Australia, Victoria, in the mallee on the ground, *J. Reader* 6 (BP! – holotype).

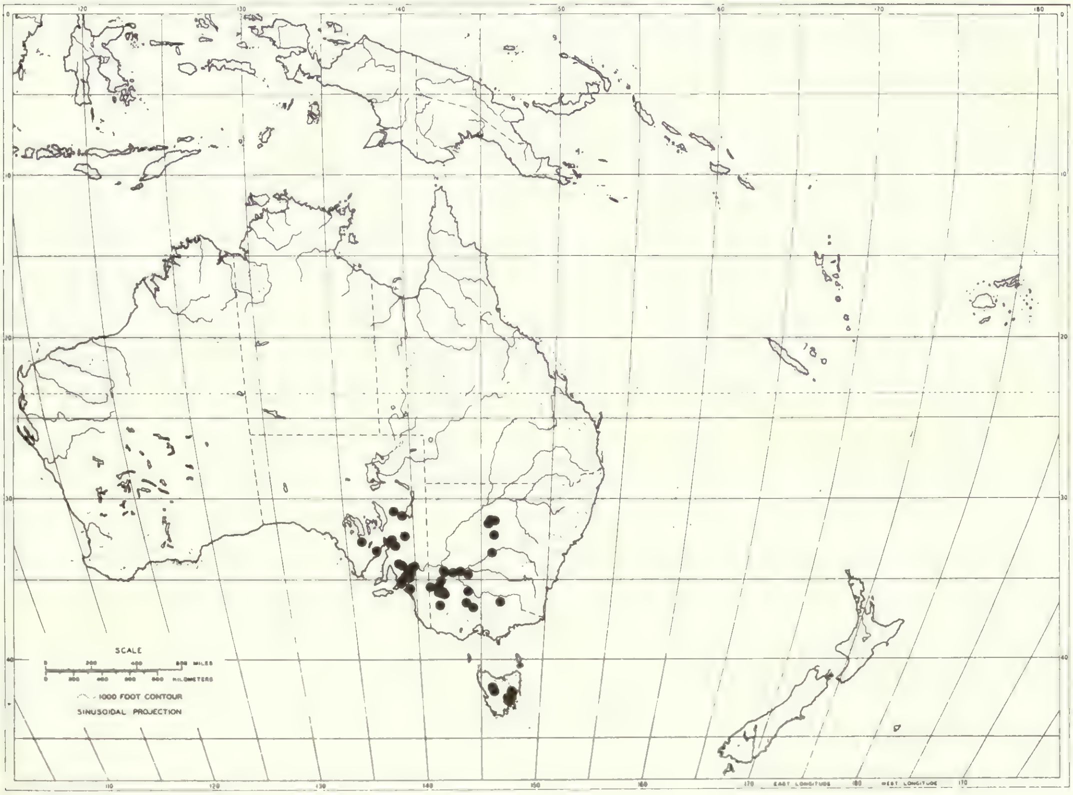
Illustration: Fig. 4.

Description. *Thallus* foliose, loosely adnate on soil, pale yellow, forming rosettes 1–3 cm diam.; *lobes* sublinear-elongate, often imbricate, dichotomously branched, ± discrete and separated near margins of thallus, 0·5–2 mm wide. *Upper surface* dull, smooth, convex, maculate especially towards apices, not black-margined but often pale blackish brown near apex, lacking soredia and isidia; medulla white. *Lower surface* canaliculate in part, yellow-brown to pale blackish brown, yellow-rimmed, sparsely to moderately rhizinate, rhizines black, simple or sparsely branched, 1–3 mm long. *Apothecia* very rare, sessile to substipitate, 1·0–2·0 mm in diameter; disc concave, dark brown; margin prominent, crenulate, persistent; spores *c.* 10 × 6 μm.

Chemistry. Cortex K−; medulla K+ yellow, C−, KC−, P+ orange; containing usnic acid, stictic acid (major), constictic acid, norstictic acid, cryptostictic acid (trace) and unknown (±).

Distribution. This species is confined to subarid areas of southern and eastern Australia (SA, NSW, Vic, Tas, SA). Map 4. On soil in mallee scrub and subarid grasslands. Specimens examined: 83.

Notes. This taxon belongs to a group of *Xanthoparmelia* species characterised by dichotomously divided lobes with a canaliculate undersurface, and by thalli forming small rosettes 1–3(–5) cm diam. on soils. Three species, *X. amphixantha, X. pseudoamphixantha,* and *X. reptans*, are further characterised by a maculate upper surface and, although they exhibit few morphological distinctions, they can readily be separated chemically. Thus *X. pseudoamphixantha* contains



Map 4 Distribution of *Xanthoparmelia amphixantha* in Australia.

norstictic and connorstictic acid, and *X. reptans* fumarprotocetraric acid and ± succinprotocetraric acid.

X. reptans is more widely distributed than the other two taxa and this distinctive distribution pattern coupled with the absence of chemical combinants attests to the species status of this taxon (Elix, 1982). Although *X. amphixantha* and *X. pseudoamphixantha* are generally sympatric and belong to the same chemosyndrome, they maintain their chemical integrity even when growing side by side, so are also given species status in this revision. The taxonomic rank of these chemotypes has been argued in detail elsewhere (Elix, 1982).

X. amphixantha is relatively common on soils in the mallee areas of SA, Vic, and NSW, where *Psora decipiens* (Hedwig) Hoffm., *Diploschistes scruposus* (Schreber) Norman, *Acarospora ferdinandii* (Müll. Arg.) Hue, *Xanthoparmelia terrestris*, and *Chondropsis semiviridis* (Nyl.) Nyl. are regular associates.

Key to the *Xanthoparmelia amphixantha* group in Australasia

Thallus forming yellow or pale yellow-green rosettes or subfruticose clumps on soil, lobes ± convex, canaliculate below.

1a.	Lobes esorediate	2
1b.	Lobes sorediate	8
2a(1a).	Upper surface maculate, especially towards apices	3
2b.	Upper surface emaculate	6
3a(2a).	Medulla K+ yellow or K+ yellow-red	4
3b.	Medulla K−, P+ orange-red (fumarprotocetraric, ± succinprotocetraric acids)	5
4a(3a).	Medulla K+ yellow-deep red (norstictic, connorstictic acids)	**84. X. pseudoamphixantha** (p. 309)
4b.	Medulla K+ yellow (stictic, constictictic acids)	**4. X. amphixantha** (p. 190)
5a(3b).	Thallus forming rosettes, lobes regularly dichotomously branched, moderately rhizinate	**89. X. reptans** (p. 316)
5b.	Thallus ± subfruticose, lobes entangled, irregularly to subdichotomously branched, sparsely rhizinate	**115. X. willisii** (p. 355)
6a(2b).	Thallus forming regular rosettes	7
6b.	Lobes entangled, thallus subfruticose; medula K+ faint pink (hypostictic, hyposalazinic acids)	**102. X. sulcifera** (p. 335)
7a(6a).	Lower surface yellow to pale tan, medulla K+, yellow-red (salazinic acid)	**13. X. bellatula** (p. 203)
7b.	Lower surface brown to dark brown, medulla K−, KC+ rose (loxodin, norlobaridone)	**33. X. eilifii** (p. 235)
8a(1b).	Medulla K+ yellow (stictic, constictic acids)	**8. X. aurifera** (p. 197)
8b.	Medulla K+ brown (fumarprotocetraric, succinprotocetraric acids)	**18. X. concomitans** (p. 210)

5. **Xanthoparmelia amplexula** (Stirton) Elix & Jen Johnston, **comb. nov.**

Basionym: *Parmelia amplexula* Stirton in *Trans. Proc. R. Soc. Vict.* **17**: 69 (1881). Type: Australia, Queensland, near Brisbane, *Bailey* 262 (BM! – holotype).

= *Parmelia violascens* Stirton in *Trans. Proc. N.Z. Inst.* **32**: 77 (1899). Type: Australia, Victoria, Grampian Mountains, *Sullivan* (BM! – holotype).

Illustration: Galloway in *N.Z. Jl Bot.* **18**: 542 (1981) (as *Xanthoparmelia scabrosa*).

DESCRIPTION. *Thallus* foliose, adnate to moderately adnate on rocks, yellow-green or commonly blackening towards the centre because of the presence of dark-tipped, dense isidia; subirregularly lobate, 5–10 cm diam.; *lobes* sublinear-elongate, sparingly imbricate or not, 0·8–2·0(–3·0) mm wide. *Upper surface* opaque, emaculate, with sparse to numerous isidia, *isidia* cylindrical, simple or branched and coralloid up to 2 mm high; medulla white. *Lower surface* pale brown to dark brown, sparsely to moderately rhizinate, rhizines concolorous with lower surface, simple, slender. *Apothecia* rare, 1·5–6·0 mm diam.; disc strongly concave to ± flat at maturity, dark brown, shining; margin thin, persistent, involute at first, isidiate; spores 7–12 × 5–6 μm.

Chemistry. Thallus K−; medulla K−, C−, KC+ rose, P−; containing usnic acid, loxodin (±), norloboridone, scabrosin 4,4′-diacetate (±), scabrosin 4-acetate-4′-butyrate (±), scabrosin 4,4′-dibutyrate (±), scabrosin 4-acetate-4′-hexanoate (±), and rarely traces of norlobariol (±), isonorlobaridone (±), norlobariol methyl ester (±), conorlobaridone (±), constipatic acid (±), protoconstipatic acid (±), unknown (±).

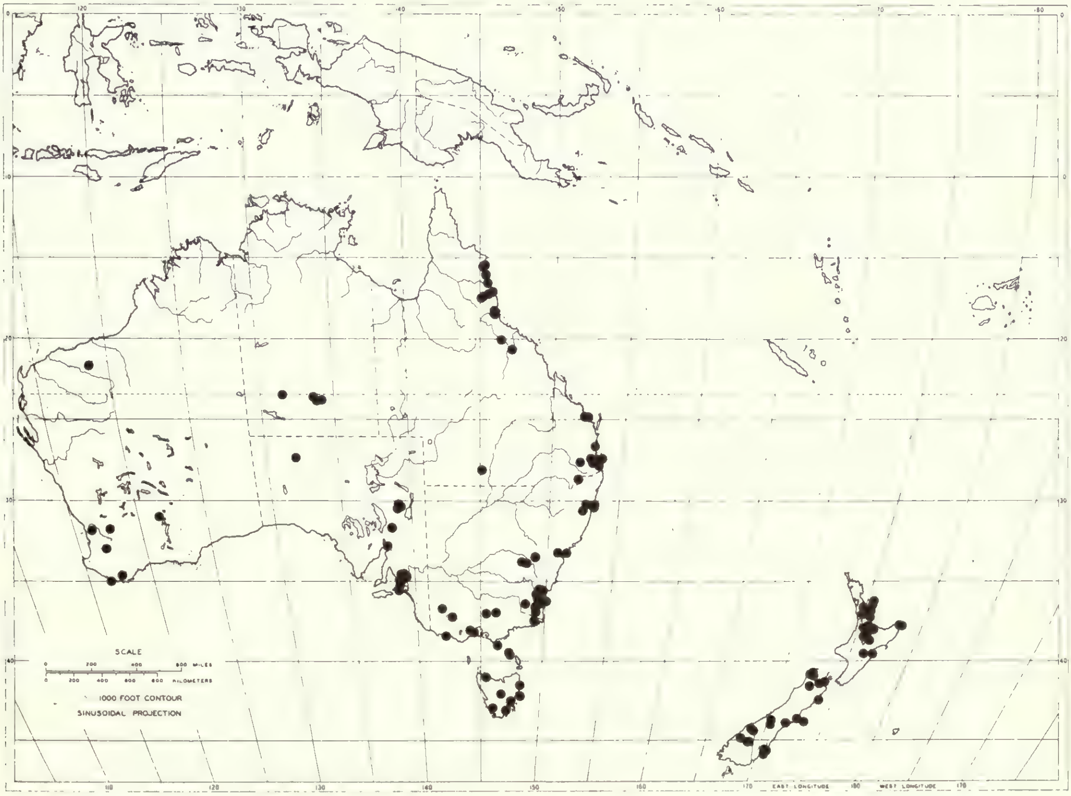
Distribution. Widely distributed and common in Australia (all states, ACT, NT) and New Zealand. Also occurs in Africa. Map 5. On rocks, rarely on dead wood and soil. Specimens examined: 241.

Notes. *X. amplexula* is characterised by the presence of isidia, a pale lower surface, and the production of usnic acid, loxodin (±), and norlobaridone. Three other species exhibit a similar combination of features, viz., *X. exillima, X. scabrosa,* and *X. constipata*.

X. scabrosa differs from *X. amplexula* in the nature of the isidia: *X. amplexula* having slender, cylindrical isidia which may or may not be branched, while in *X. scabrosa* the warty or globose isidia develop into dactyls, becoming inflated at the apices and ultimately burst open. Thalli of *X. scabrosa* are usually more loosely adnate than those of *X. amplexula*.

Both *X. amplexula* and *X. scabrosa* have foliose thalli with elongated lobes 1–3 mm wide, while the third related species, *X. exillima*, is almost subcrustose with narrow (0·2–0·5 mm) highly congested lobes, and does not normally produce loxodin. Like *X. amplexula, X. exillima* has true cylindrical isidia.

The fourth species, *X. constipata*, is distinguished by its substrate preference (terricolous), the much thicker thallus, and the nature of the isidia. The robust isidia (*c.* 0·2 mm wide) are often



Map 5 Distribution of *Xanthoparmelia amplexula* in Australia and New Zealand.

flattened towards the apices, and consequently appear sublobulate and ultimately become erumpent.

X. amplexula is common on rocks from arid central Australia to moist areas in Tasmania, and also on South Island, New Zealand.

6. **Xanthoparmelia antleriformis** (Elix) Elix & Jen Johnston, **comb. nov.**

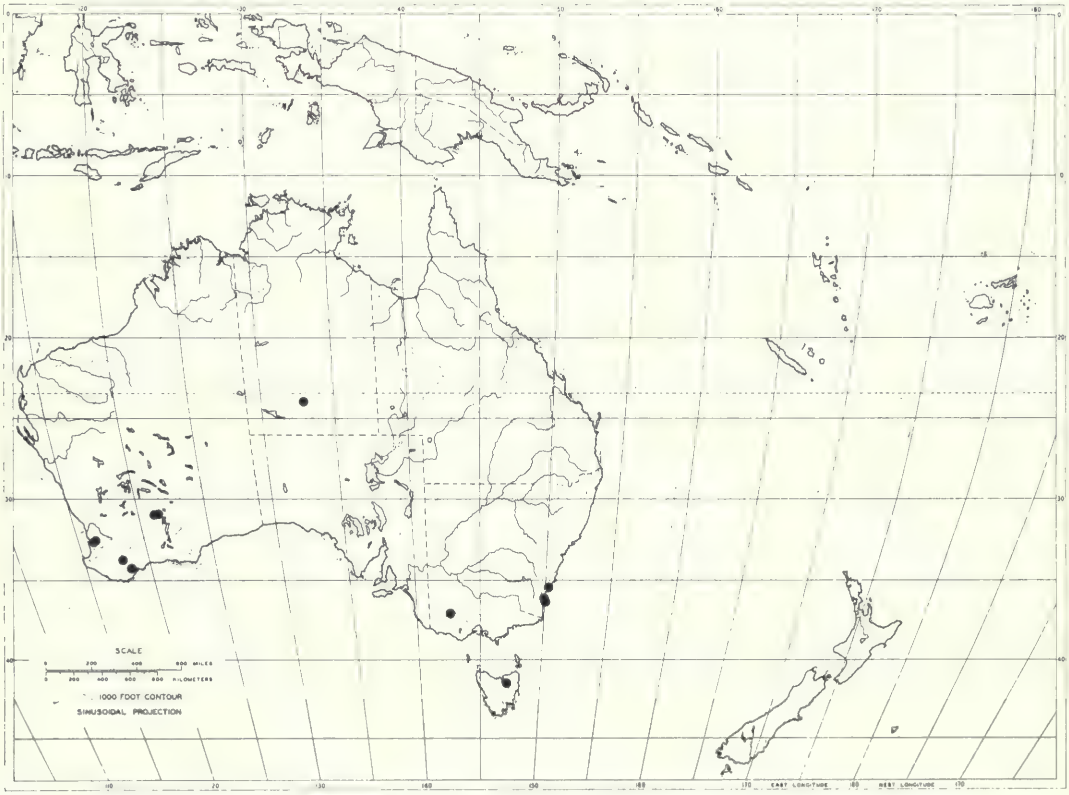
Basionym: *Parmelia antleriformis* Elix in *Aust. J. Bot.* **29**: 349 (1981). Type: Australia, Western Australia, Eyre district, 2 km south-west of Pallinup River Crossing on Highway 1 towards Albany, 34°25′ S, 118°43′ E on metamorphic rock, *B. Barnsley* 602 (CBG 7901116! – holotype; MEL! – isotype).

Illustration: Elix (op. cit.).

Description. *Thallus* small foliose, adnate on rocks, yellow-green, darkening with age, radiating at first but eventually becoming irregularly lobate, 3–5 cm diam.; *lobes* imbricate or not, sublinear-elongate, 0·3–1·0 mm wide, older lobes irregularly fractured and areolae commonly formed. *Upper surface* opaque, emaculate, commonly with tangential cracks, densely isidiate, *isidia* cylindrical at first but becoming extensively branched, coralloid or antler-like, up to 0·3 mm in diameter and 0·5–3·0 mm high; medulla white. *Lower surface* pale brown becoming darker near lobe apices, moderately rhizinate, rhizines simple, brown. *Apothecia* adnate, 2–5 mm in diameter, concave at first but then undulate, margin thick, entire, becoming densely isidiate, disc dark brown; spores 6–8 × 3·5–4·5 μm.

Chemistry. Thallus K−; medulla K+ yellow than red; C−, P+ intense yellow; containing usnic acid, salazinic acid, consalazinic acid, and (±) traces of norstictic acid.

Distribution. Hinterland areas of southern NSW, Vic, Tas, and southern WA. Also occurs in NT. Map 6. Specimens examined: 31.



Map 6 Distribution of *Xanthoparmelia antleriformis* in Australia.

NOTES. This distinctive species is characterised by moderately adnate thalli, narrow lobes with a pale undersurface, and by abundant isidia, the dimensions of which occasionally exceed that of the lobes.

Morphologically this species resembles both *Xanthoparmelia mougeotina* and *X. streimannii*. The more diminutive thallus of *X. mougeotina* is readily distinguished however, by its brown-black lower surface, and the production of usnic acid and the stictic acid complex. By contrast, thalli of *X. streimannii* are generally larger and more robust than those of *X. antleriformis*, with broader lobes and again a distinctive chemistry. *X. streimannii* produces norstictic acid and connorstictic acid in the medulla.

The presence of isidia, the pale undersurface of the lobes, and the production of salazinic acid also bring to mind *X. consociata* and *X. mexicana*. However the latter species has broad lobes (1–2(–5) mm wide) with rotund apices, although in some areas it does tend to intergrade with *X. antleriformis*. The distinguishing features of *X. consociata* are discussed under that species.

X. antleriformis is locally common on outcrops of Hawkesbury sandstone in NSW and lateritic rocks of the Darling Ranges in WA. Other species of *Xanthoparmelia* commonly associating with this species include *X. mougeotina, X. exillima, X. streimannii*, and *X. adhaerens*.

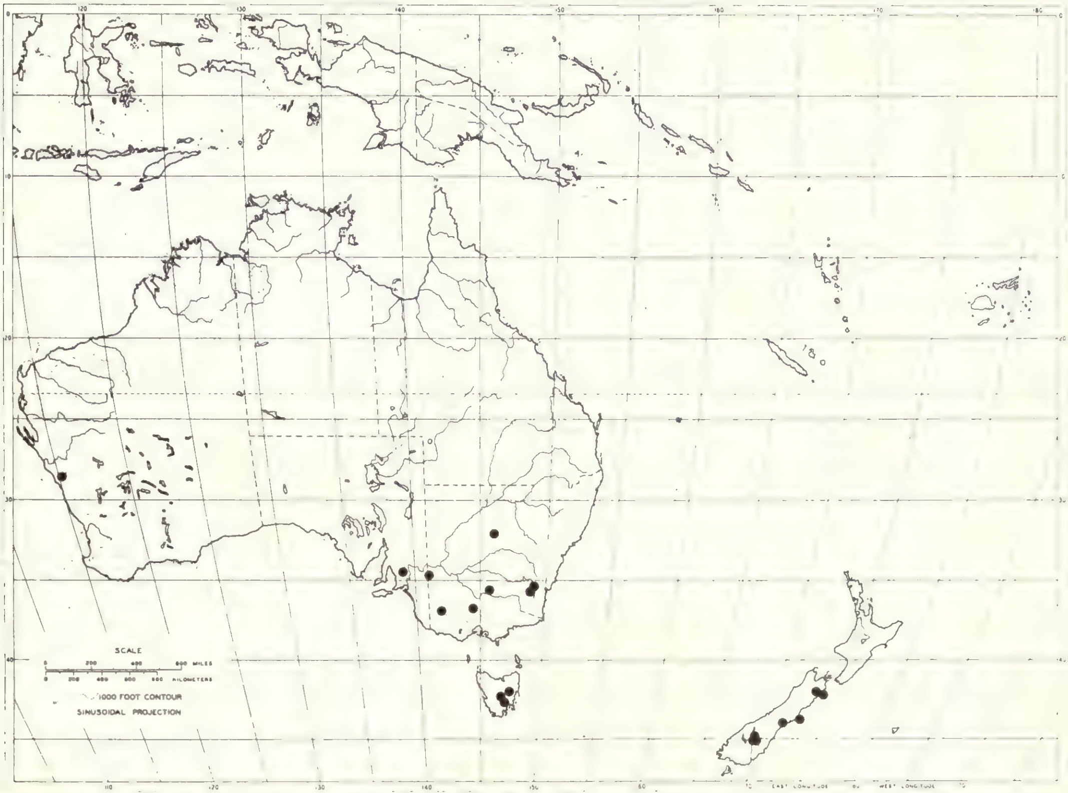
7. **Xanthoparmelia arapilensis** (Elix & P. Armstr.) Filson

in *Brunonia* 7: 205 (1984).

≡ *Parmelia arapilensis* Elix & P. Armstr. in *Aust. J. Bot.* **31**: 467 (1983). Type: Australia, Victoria, Mount Arapiles, 24 October 1948, *A. C. Beauglehole* 1218 (MEL 1023354! – holotype).

Illustration: Elix & Armstrong (op. cit.).

DESCRIPTION. *Thallus* foliose, loosely adnate on rocks or soil, yellow-green, irregularly lobate, 6–8 cm diam.; *lobes* irregular, sparingly imbricate or not, 2·0–5·0(–8·0) mm wide, apices



Map 7 Distribution of *Xanthoparmelia arapilensis* in Australia and New Zealand.

crenulate, more or less rotund. *Upper surface* slightly shiny or dull, weakly maculate or not, lacking isidia and soredia, becoming rugose and cracked with age, margins commonly blackened; medulla white. *Lower surface* pale ivory to brown, darker towards apices, moderately to densely rhizinate, rhizines concolorous with lower surface, simple or sparingly branched. *Apothecia* adnate, 2–5 mm in diameter, the margin involute at first but later becoming undulate and cracked; spores 9–10 × 5–6 μm.

CHEMISTRY. Thallus K−, medulla K+ yellow then red, C−, P+ intense yellow; containing usnic acid, norstictic acid (major), connorstictic acid, and salazinic acid (±).

DISTRIBUTION. Southern Australia (NSW, ACT, Vic, Tas, SA, WA) and South Island, New Zealand (Otago, Canterbury). Map 7. On exposed rocks, from subarid areas and areas of moderate rainfall. Specimens examined: 32.

NOTES. Morphologically this species closely resembles *Xanthoparmelia taractica*, as both species are loosely adnate to rocks and soil and have broad lobes with a pale, densely rhizinate lower surface. However *X. arapilensis* has somewhat broader (3–5(–8) mm wide) and shorter lobes which are scarcely imbricate, it generally lacks the narrower secondary lobes common in *X. taractica*, and contains norstictic acid and usnic acid together with traces of salazinic acid and connorstictic acid; the lobes of *X. taractica* are somewhat narrow (2–4 mm wide), densely imbricate, and contain usnic acid and salazinic acid.

Chemically this species is identical with *X. elixii* which also has a pale lower surface. The lower surface of *X. elixii*, however, is sparsely rhizinate, the lobes narrower (1–2·5 mm) and often subascending at the apices, while the broader, moderately to densely rhizinate lobes of *X. arapilensis* are always ± flat.

X. arapilensis is a widely dispersed species locally abundant in southern Australia and on South Island, New Zealand, colonising dry, well-drained rock surfaces where common associating species include *X. flavescentireagens, X. glareosa, X. notata*, and *X. tasmanica*.

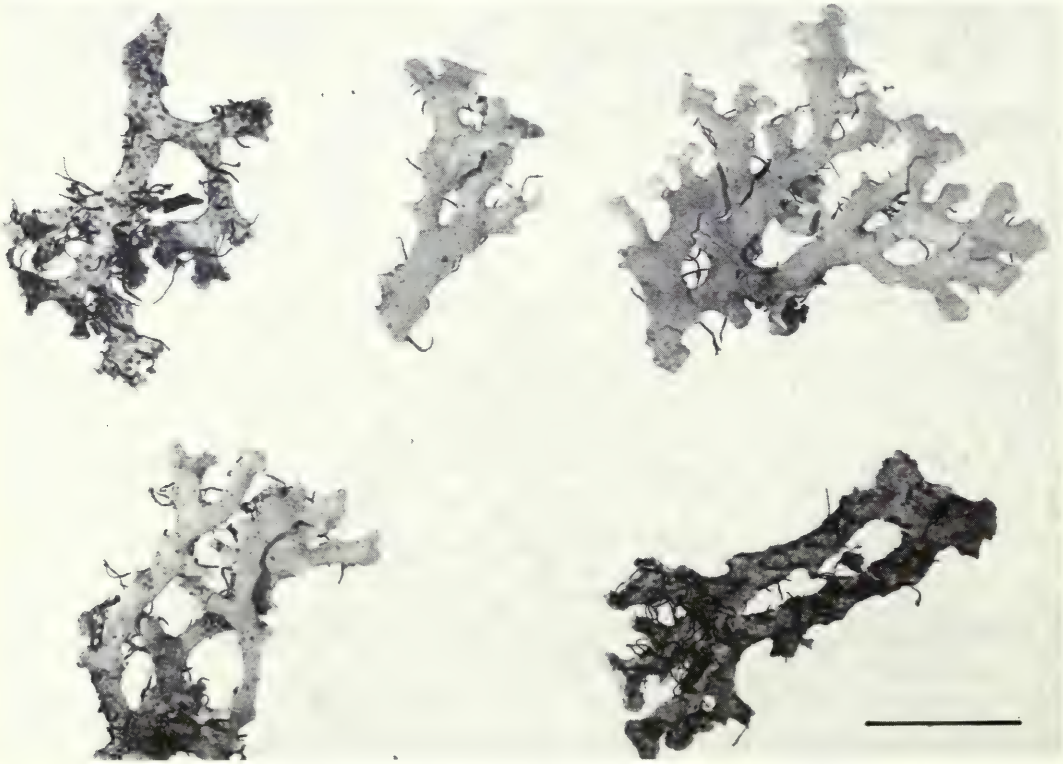


Fig. 5 *Xanthoparmelia aurifera* Elix & Jen Johnston. Portion of holotype – CBG. Scale = 1 cm.

8. **Xanthoparmelia aurifera** Elix & Jen Johnston, **sp. nov.**

Thallus ut in *Xanthoparmelia amphixantha* sed superficie superiore sorediata ad apicibus loborum differt. Thallus 175–250 μm crassus; cortex superior *c.* 20 μm crassus, stratum gonidiale non-continuum, 25–35 μm crassum, medulla 140–175 μm crassa, cortex inferior 20–28 μm crassus. Thallus K−; medulla K+ lutescens, C−, P+ aurantiaca; acidum usnicum, acidum sticticum, acidum consticticum, acidum norsticticum, acidum cryptosticticum et acidum ursolicum continens (±).

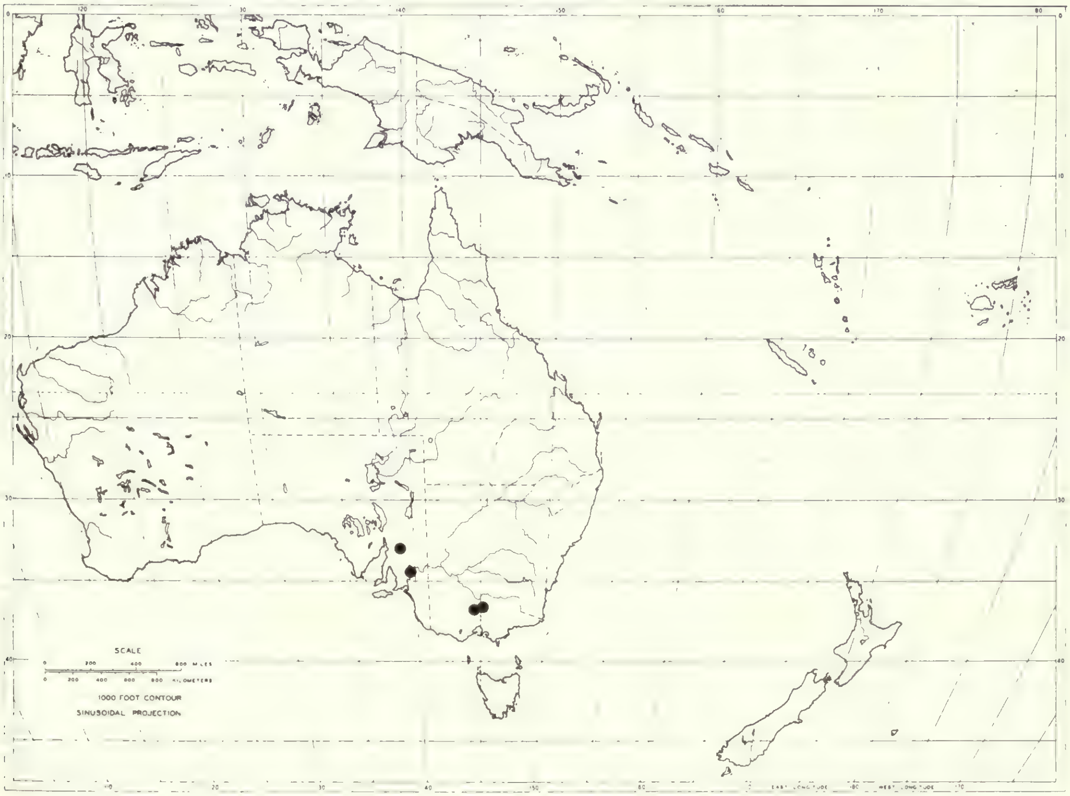
Type: Australia, Victoria, Bendigo, edge of forest behind Bendigo Gold Club at Epsom, 36°43′ S, 144°20′ E, *c.* 200 m, on soil in dry sclerophyll forest (typical goldfields scrub with *Eucalyptus sideroxylon, Cassinia arcuata, Acacia armata,* and herbs). 11 December 1983; *J. Johnston 1156* (CBG! – holotype; MEL! – isotype).

Illustration: Fig. 5.

Description. *Thallus* foliose, loose or loosely adnate on soil, pale yellow to pale yellow-green, forming rosettes 0·5–2 cm diam.; *lobes* sublinear-elongate, subdichotomously to dichotomously branched, imbricate or not, ± separated near thallus margin, 0·2–1·0(–2·0) mm wide. *Upper surface* dull, maculate, weakly convex, sorediate, apices (and rarely upper surface and margin) of lobes becoming swollen and developing terminal, subcapitate soralia, soredia farinose; lacking isidia; medulla white. *Lower surface* canaliculate in part, pale yellow to yellow-brown, sparsely to moderately rhizinate, rhizines black, simple or rarely sparsely branched. *Apothecia* not seen.

Chemistry. Cortex K−; medulla K+ yellow, C−, P+ orange; containing usnic acid, stictic acid (major), constictic acid, norstictic acid, cryptostictic acid (trace), and ursolic acid (±).

Distribution. Known only from central Victoria and southeastern SA. Map 8. On soil in dry sclerophyll forest. Specimens examined: 4.



Map 8 Distribution of *Xanthoparmelia aurifera* in Australia.

NOTES. This distinctive species is distinguished by the presence of soredia and the weakly convex, dichotomously branched lobes with a canaliculate lower surface. Morphologically it closely resembles *X. amphixantha*, and is often found growing together with the latter species. Although these two taxa are chemically identical, we are maintaining them as separate species at this stage, *X. aurifera* being considered the sorediate counterpart of *X. amphixantha*.

X. aurifera is morphologically comparable with *X. concomitans*, although it can be readily separated chemically. Thus *X. aurifera* contains the stictic acid complex, while *X. concomitans* contains fumarprotocetraric acid and succinprotocetraric acid. A similar rationale can be forwarded for maintaining these chemical races as distinct species as that argued for distinguishing *X. amphixantha* and *X. reptans*.

This species is rare in southern Australia, where associated lichens include *Cladia aggregata* (Swartz) Nyl., *Cladia corallaizon* R. Filson, *Xanthoparmelia amphixantha, X. flavescentireagens*, and *X. substrigosa*.

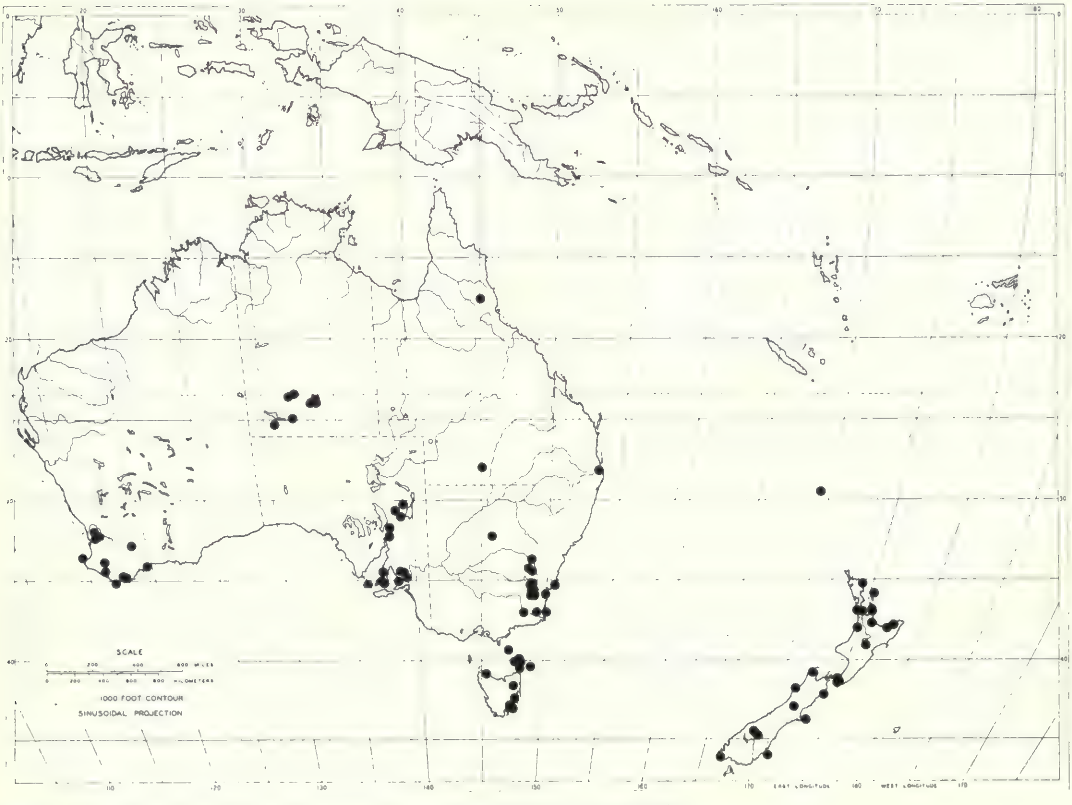
9. Xanthoparmelia australasica D. Galloway

in *N.Z. Jl. Bot.* **18**: 531 (1981). Type: New Zealand, North Auckland, Karekare Beach, on andesitic conglomerate, 8 October 1977, *J. Bartlett* (CHR 314047! – holotype; CHR! – isotypes).

≡ *Parmelia australasica* (D. Galloway) Filson in *Aust. J. Bot.* **30**: 519 (1982).

Illustration: Galloway (op. cit.).

DESCRIPTION. *Thallus* foliose, moderately to loosely attached to the substrate, yellow-green, 5–12(–20) cm diam. *Lobes* irregular, 2·0–3·5(–5·0) mm wide, often markedly imbricate, secondary lobes similar to marginal lobes, sometimes building thallus up into a thick mat, apices subrotund. *Upper surface* smooth, shining at margins, wrinkled and cracked centrally, emacu-



Map 9 Distribution of *Xanthoparmelia australasica* in Australasia.

late, moderately to densely isidiate, *isidia* laminal often forming a dense areolate crust, robust, broad, cylindrical, extensively coralloid branched, to 2·5 mm tall; medulla white. *Lower surface* black with a narrow, brown, naked marginal zone, smooth and shining at margins, matt and wrinkled at centre, sparsely rhizinate, rhizines simple, black. *Apothecia* rare, 2–6(–8) mm diam., sessile, deeply concave when young becoming shallowly convex with age, disc smooth, red-brown, margin conspicuously isidiate, exciple wrinkled, shining, becoming isidiate with age; spores 8–11 × 4–6 μm.

CHEMISTRY. Thallus K−; medulla K+ yellow than dark red, C−, KC+ red, P+ orange; containing usnic acid, salazinic acid, and consalazinic acid.

DISTRIBUTION. This species is widespread in Australia (all states, ACT, NT), New Zealand, and Norfolk Island. Map 9. It also occurs in the United States and South Africa. It is particularly common on rocks in coastal, hinterland, and even arid areas in Australia, and coastal localities in North Island, New Zealand. Specimens examined: 183.

NOTES. This mat-forming *Xanthoparmelia* is characterised by the black lower surface, the presence of densely congested isidia, and salazinic acid. Sometimes the central portion of the thallus can be hidden by a mass of isidia which gives the appearance of a dense isidiate mat. It closely resembles *Xanthoparmelia neotinctina*, but the latter species has adnate, narrower (usually 1·5–2·5 mm wide), more elongated lobes, and contains usnic acid and norstictic acid, with or without salazinic acid. On the other hand, *X. isidiigera* has the same chemistry as *X. australasica* but here the isidia are evenly dispersed, sparse, slender and sparingly branched, and the lobes are more tightly adnate and narrower. The sparse isidia of *X. isidiigera* do not become coralloid-branched as they do in *X. australasica*. *X. australasica* appears to be the isidiate counterpart of *X. tasmanica*.

Common associating species of *Xanthoparmelia* include *X. flavescentireagens, X. amplexula, X. scabrosa,* and *X. tasmanica*.

10. **Xanthoparmelia australiensis** (Crombie) Hale

in *Phytologia* **28**: 486 (1974).

≡ *Parmelia australiensis* Crombie in *J. Linn. Soc.* (Bot.) **17**: 395 (1879). Type: Australia, Tasmania?, Table Mountain, *Brown* 525 (BM – holotype).

Illustration: Fig. 6.

DESCRIPTION. *Thallus* foliose, unattached on soil, pale yellow-green or darkening in older, central lobes, 2–6 cm diam.; *lobes* elongate, convolute, contorted, 3·5–5·0 mm wide (when flattened) but 1·0–3·0 mm when dry and convoluted. *Upper surface* smooth, emaculate, becoming rugulose and cracked in older lobes, lacking soredia and isidia, marginal lobules sometimes present on older lobes. *Lower surface* pale yellow-green to brown, sparsely rhizinate, rhizines simple, concolorous with the lower surface. *Apothecia* not seen.

CHEMISTRY. Thallus K−; medulla K−, C−, KC+ rose, P−; containing usnic acid, loxodin, norlobaridone.

DISTRIBUTION. Nullarbor area and Flinders Ranges of SA. Map 10. On soil. Specimens examined: 8.

NOTES. Morphologically this species is very similar to *Xanthoparmelia convoluta* and *X. norconvoluta* and in most cases these species can only be separated by chemical tests or by thin-layer chromatography. However the three species do show different distributions within southern Australia. *X. norconvoluta*, the most wide-ranging chemical race, is sympatric with *X. australiensis* in the Nullarbor region and with *X. convoluta* in the Murray mallee area (Maps 10, 24, 76). No chemical intermediates were observed in these areas of sympatry; the different distributions of the chemotypes convinced us to maintain these taxa as distinct species.

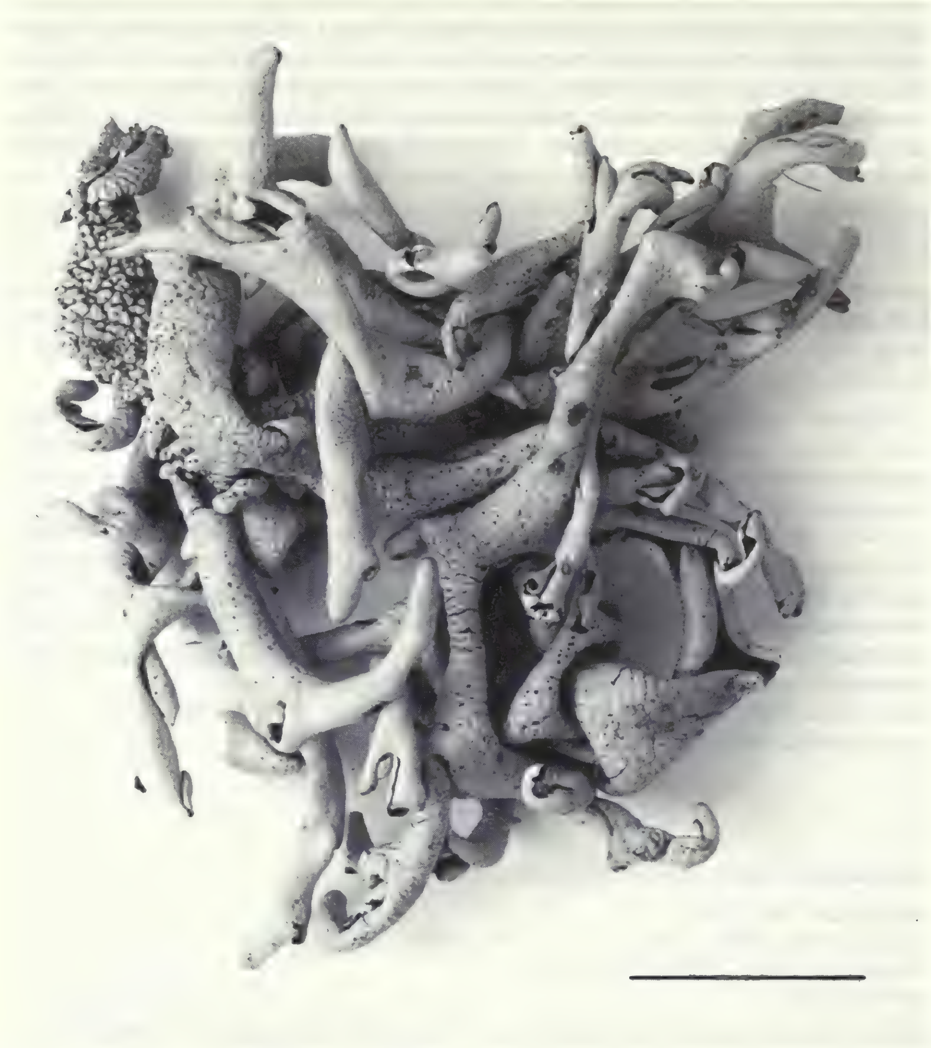


Fig. 6 *Xanthoparmelia australiensis* (Crombie) Hale. *Filson* MEL 25312. Scale = 1 cm.

The locality reported for the type specimen obviously appears to be in error (Filson, 1982: 521). In fact it has a restricted distribution in arid South Australia where it grows on soil together with *Psora decipiens* (Hedwig) Hoffm., *Chondropsis semiviridis* (Nyl.) Nyl., and *Diploschistes scruposus* (Schreber) Norman.

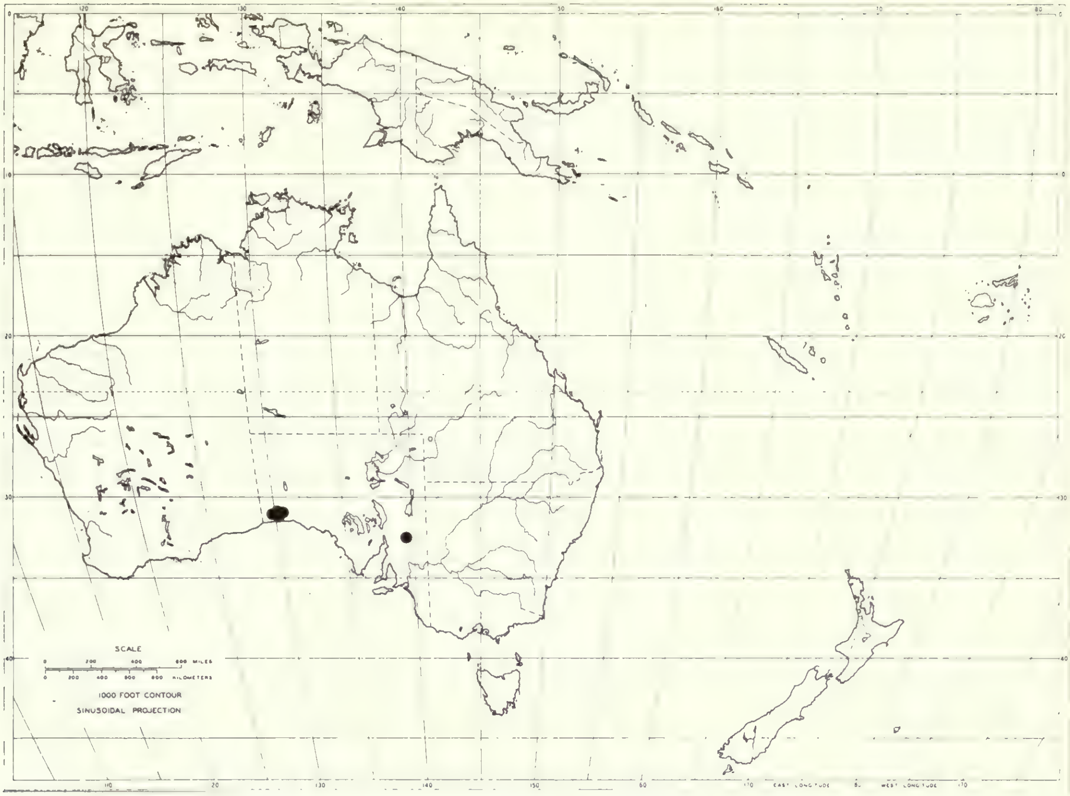
11. **Xanthoparmelia barbatica** (Elix) Egan

in *Bryologist* **85**: 129 (1982).

≡ *Parmelia barbatica* Elix in *Aust. J. Bot.* **24**: 663 (1976). Type: Australia, Australian Capital Territory, Kowen Forest, 18 km E. of Canberra, 730 m, on sandstone rocks, *J. A. Elix* 1389 (MEL 1015396! – holotype; CANB! – isotype).

Illustrations: Elix (op. cit.); Egan (op. cit.).

Description. *Thallus* foliose, tightly adnate on rocks, 4–7 cm wide, yellow-green, *lobes* radiating at first but becoming subirregular, imbricate or not, 1·0–3·0 mm wide, marginally subrotund, sometimes developing narrower (0·7–1·5 mm), sublinear-elongate secondary lobes.



Map 10 Distribution of *Xanthoparmelia australiensis* in Australia.

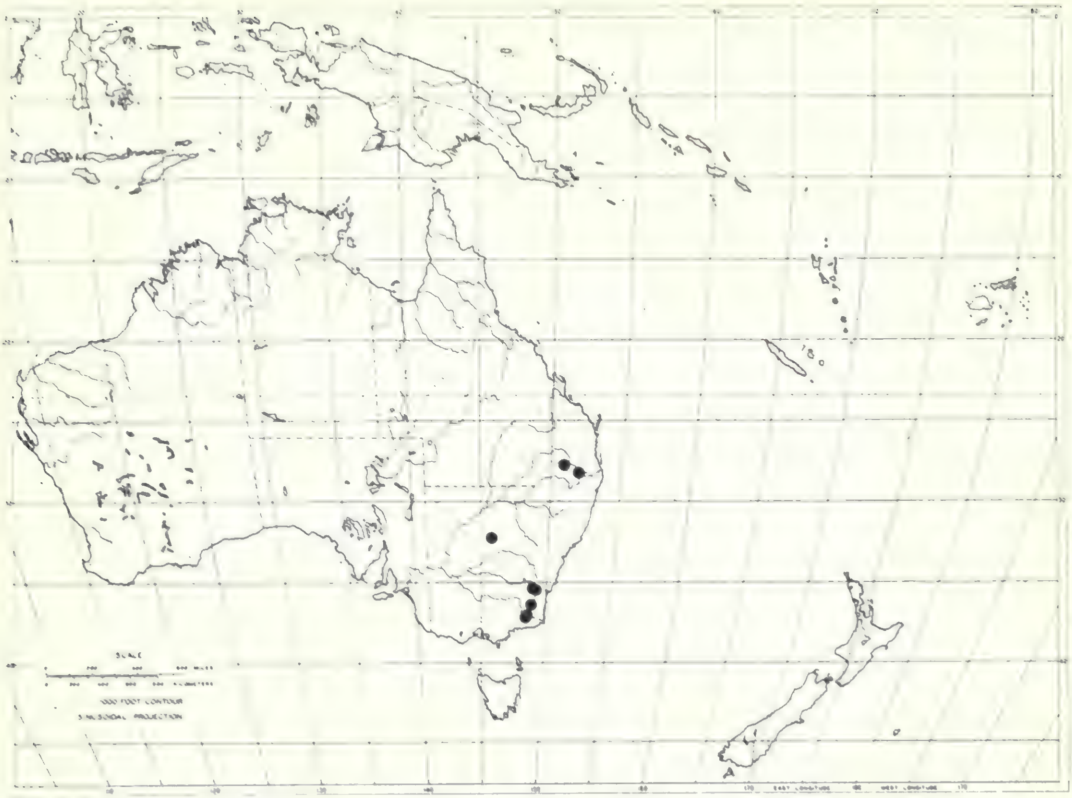
Upper surface dull, emaculate, with tangential or irregular cracks, becoming distinctly rugulose in older lobes, lacking isidia and soredia; medulla white. *Lower surface* pale brown to dark brown, moderately rhizinate, rhizines yellow-brown to black, simple, 0·3–0·5 mm long. *Apothecia* adnate, 0·7–3·5 mm diam., margin thick inrolled at first, becoming thin and slightly lacerate, disc dark brown, concave then undulate, amphithecium smooth; spores 7–9 × 4–6 μm.

CHEMISTRY: Cortex K−; medulla K−, C−, KC+ yellow, P−; containing usnic acid, barbatic acid (major), 4-*O*-demethylbarbatic acid, dehydroconstipatic acid, and ± traces of constipatic acid, 3-α-hydroxybarbatic acid.

DISTRIBUTION. Eastern Australia (Qld, NSW, ACT, Vic). Map 11. Also in southern U.S.A. (Texas). On exposed rocks in subarid regions or areas of moderate rainfall. Specimens examined: 22.

NOTES. Morphologically this species resembles the *Xanthoparmelia lineola* group – including *X. filarszkyana, X. metaclystoides, X. pertinax, X. tucsonensis,* and *X. subdomokosii.* These lichens are characterised by their tightly adnate thalli, broad, rotund marginal lobes, a pale lower surface, and by the upper surface in older lobes often being tangentially cracked. *X. barbatica* differs from the other species by intermittently developing narrower, loosely adnate secondary lobes. Five of the species exhibit a K− medullary reaction, but can be readily distinguished by thin-layer chromatography since *X. filarszkyana* contains loxodin and norlobaridone, *X. pertinax* contains fumarprotocetraric acid and succinprotocetraric acid, *X. tucsonensis* contains diffractaic acid as the major component, *X. subdomokosii* contains hypoprotocetraric acid, while *X. barbatica* contains barbatic acid as the major component.

Chemically *X. barbatica* appears to be closely related to *X. tucsonensis* as these two species exhibit typical chemosyndromic variation of the β-orcinol *para*-depsides related to barbatic acid



Map 11 Distribution of *Xanthoparmelia barbatica* in Australia.

(Culberson, Nash & Johnson, 1979). Interestingly both species exhibit a disjunct distribution between southern Australia and south-western U.S.A.

X. barbatica is a relatively rare and scattered species in Australia. Common associates include *Neofuscelia pulla* (Ach.) Essl., *Xanthoparmelia sabrosa*, *X. filarszkyana*, and *X. flavescentireagens*.

12. **Xanthoparmelia barbellata** (Kurok.) Hale

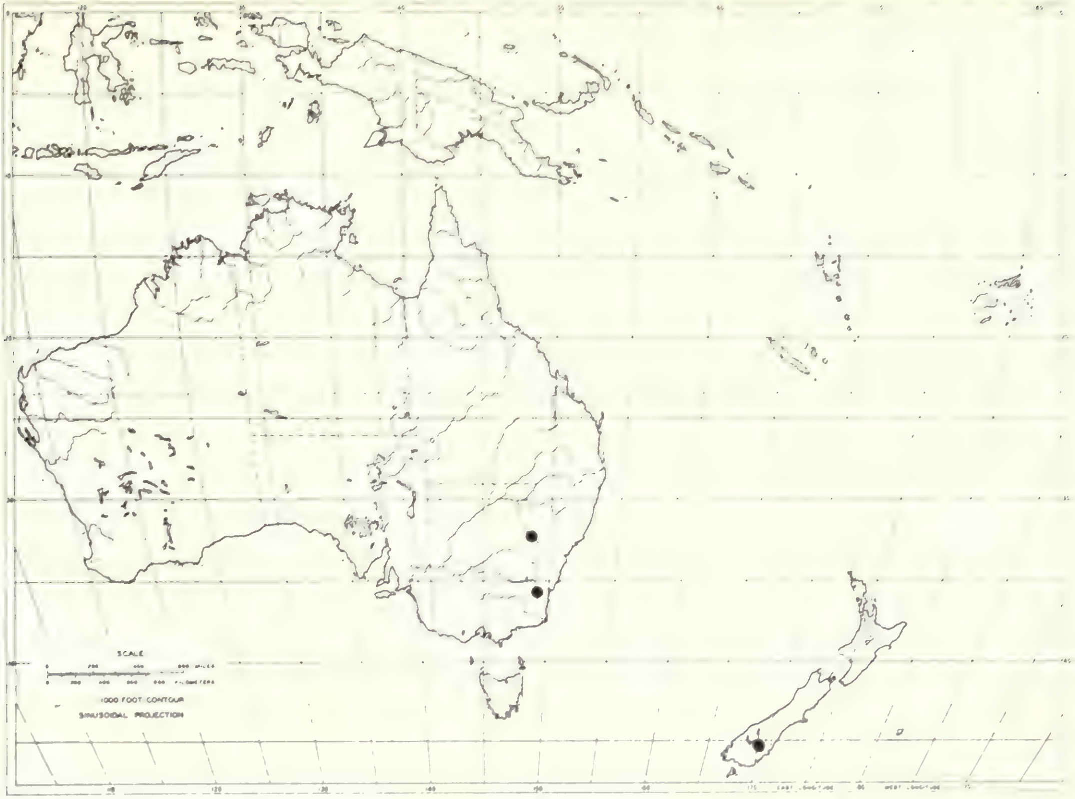
in *Mycotaxon* **20**: 79 (1984).

≡ *Parmelia barbellata* Kurok. in *Bull. natn. Sci. Mus. Tokyo* B, **8**: 35 (1982). Type: Australia, New South Wales, 15 km east of Cooma on Numeralla Road, *c.* 850 m, *S. Kurokawa* 6452 (TNS – holotype).

Illustration: Kurokawa (op. cit.).

Description. *Thallus* foliose, adnate to loosely adnate, yellow-green, darkening with age, subirregularly lobate, 4–6 cm diam.; *lobes* imbricate or not, irregular, 1·0–3·0 mm wide, marginally subrotund, secondary lobes narrower than marginal lobes, 0·7–1·5 mm wide. *Upper surface* slightly shiny or dull, emaculate, lacking soredia and isidia, margins commonly blackened; medulla white but intermittently yellow or orange adjacent to lower cortex. *Lower surface* pale brown to brown or brown-black, sparsely to moderately rhizinate, rhizines grouped subapically, pale brown to brown-black, simple or dichotomously branched, 0·5–1·2 mm long. Occasionally the lower cortex and rhizines are also pigmented (orange). *Apothecia* adnate, 2–8 mm diam., disc brown to dark brown, shiny, concave then undulate-distorted, margin thin, involute at first, entire, deeply lacerate in older structures; spores 6–7 × 3·5–5·5 μm.

Chemistry. Thallus K−; medulla K+ yellow-red, C−, P+ intense orange (pigment K+ violet);



Map 12 Distribution of *Xanthoparmelia barbellata* in Australia and New Zealand.

containing usnic acid, norstictic acid, salazinic acid, connorstictic acid, consalazinic acid, and skyrin.

DISTRIBUTION. South-eastern Australia (NSW, ACT) and South Island, New Zealand (Central Otago). Map 12. On rocks in subalpine areas with moderate to low rainfall. Specimens examined: 5.

NOTES. This species appears to be related to *Xanthoparmelia substrigosa* and *X. elixii*, since all three species have irregular lobes, a brown lower surface, and produce norstictic and salazinic acid. Like *X. substrigosa, X. barbellata* often has long, dichotomously branched rhizines, but the lower surface of *X. barbellata* is usually more sparsely rhizinate than that of *X. substrigosa*, and the lobes are more contiguous and more imbricate.

X. barbellata is clearly distinguished by the yellow or yellow-orange medulla adjacent to or on the lower cortex due to the presence of the pigment skyrin. The lower medulla is not pigmented throughout, but intermittently.

This species also resembles *X. ferruma* which also has a yellow-orange lower medulla containing skyrin, and a pale lower surface. However, *X. ferruma* is tightly adnate to the substrate in contrast to the loosely adnate lobes of *X. barbellata*. Further, *X. ferruma* produces only salazinic acid in the medulla.

X. barbellata has a rather scattered distribution, preferring drier subalpine habitats, where it grows on exposed rocks together with other species of *Xanthoparmelia*, including *X. substrigosa, X. flavescentireagens, X. scabrosa,* and *X. tasmanica*.

13. Xanthoparmelia bellatula (Kurok. & Filson) Elix & Jen Johnston, **comb. nov.**

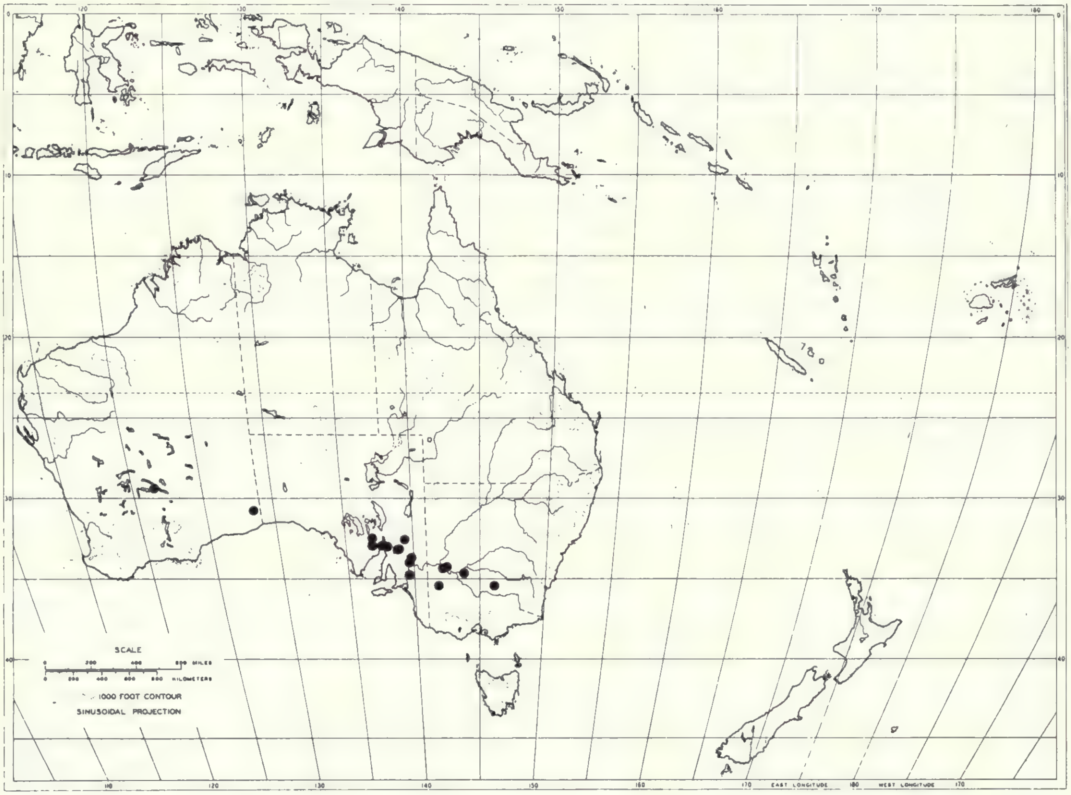
Basionym: *Parmelia bellatula* Kurok. & Filson in Filson in *Aust. J. Bot.* **30**: 521 (1982). Type: Australia, Victoria, 10 km west of Red Cliffs along the Werrimull Road, *c.* 50 m., *S. Kurokawa* 6620 (TNS – holotype; MEL 1522912! – isotype).

Illustration: Filson (op. cit.).

DESCRIPTION. *Thallus* foliose, loosely adnate on soil, forming rosettes to 4 cm diam., pale yellow to yellow-green, darker greenish-yellow towards centre; *lobes* sublinear elongate, often imbricate, dichotomously branched, ± discrete and separated near margins of thallus, 0·5–1·6 mm wide. *Upper surface* smooth, moderately convex, marginal lobes emaculate, lacking soredia and isidia; medulla white. *Lower surface* canaliculate, pale brown with a narrow marginal band concolorous with the upper surface, sparsely rhizinate, rhizines black, simple or rarely sparsely branched. *Apothecia* not seen.

CHEMISTRY. Thallus K−; medulla K+ yellow becoming red, C−, KC−, P+ yellow becoming orange; containing usnic acid, salazinic acid, and (±) consalazinic acid.

DISTRIBUTION. Inland WA and the Murray mallee area of SA, Vic, NSW. Map 13. On soil in subarid areas. Specimens examined: 23.



Map 13 Distribution of *Xanthoparmelia bellatula* in Australia.

NOTES. This species resembles *Xanthoparmelia amphixantha* and belongs to the *X. amphixantha* group, which is characterised by the dichotomously divided lobes with a canaliculate lower surface, and by the thalli forming small rosettes on soil. However, the lobes of *X. amphixantha* are distinctly maculate towards the apices and this species contains usnic acid and the stictic acid complex, while in *X. bellatula* the lobes are emaculate and produce salazinic acid and usnic acid. For further discussion of this group see *X. amphixantha.*

X. bellatula is sympatric with *X. amphixantha* in the Murray mallee where both species are common on bare soil.

14. **Xanthoparmelia bungendorensis** (Elix) Elix & Jen Johnston, **comb. nov.**

Basionym: *Parmelia bungendorensis* Elix in *Aust. J. Bot.* **29**: 351 (1981). Type: Australia, New South Wales, 3 km east of Bungendore, 840 m, on granite rocks in dry sclerophyll forest, *J. A. Elix* 3025 (MEL! – holotype).

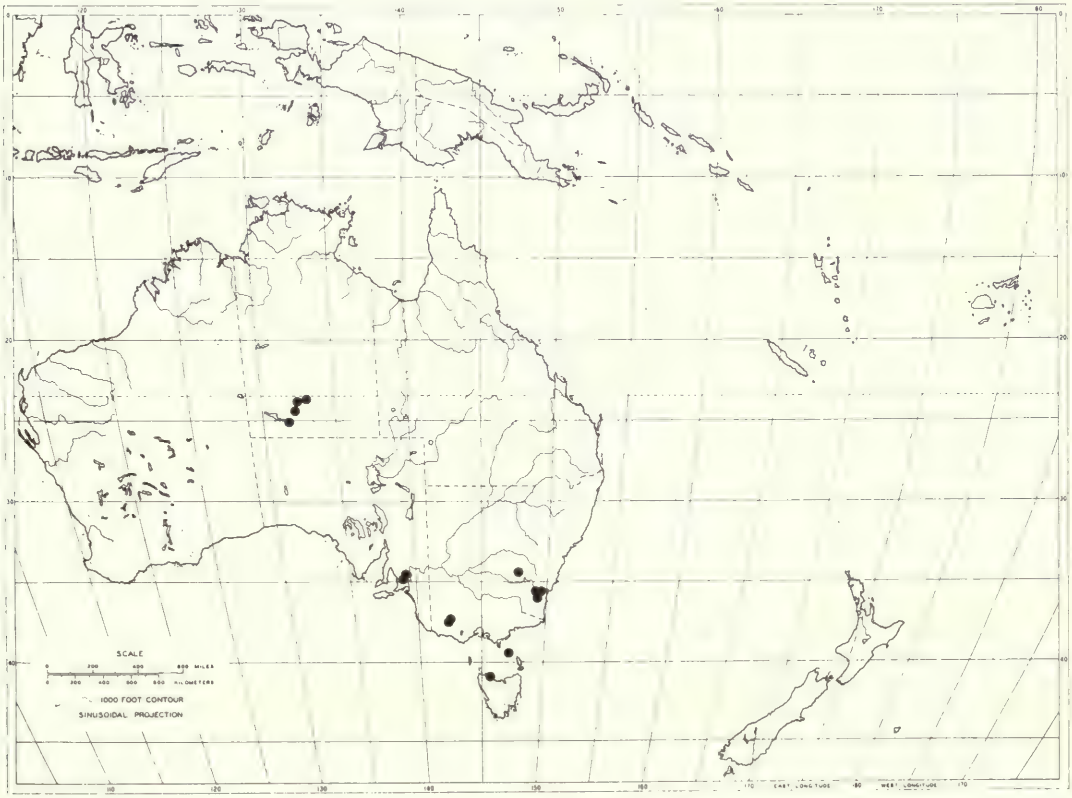
Illustration: Elix (op. cit.).

DESCRIPTION. *Thallus* foliose, moderately to loosely adnate on rocks, yellow-green, subirregularly lobate, 7–10 cm wide; *lobes* subirregular to sublinear-elongate, sometimes imbricate, apices subascending or not, 1·0–4·0 mm wide. *Upper surface* shiny, emaculate, lobes often with black margins, lacking soredia and isidia. *Lower surface* pale brown to dark brown, sparsely to moderately rhizinate, rhizines yellow-brown to blackish-brown, simple, robust. *Apothecia* substipitate, 1·5–5·0 mm diam., disc dark brown, margin entire, involute at first, becoming undulate with age; spores 8·5–9·6 × 4·5–5·5 μm.

CHEMISTRY. Thallus K−; medulla K−, C−, KC−, P−; containing usnic acid, scabrosin 4,4′-diacetate, scabrosin 4-acetate-4′-butyrate, scabrosin 4,4′-dibutyrate, scabrosin 4-acetate-4′-hexanoate.

DISTRIBUTION. Southern and central Australia (NSW, ACT, Vic, Tas, SA, NT). Map 14. On exposed rocks in arid, subarid, temperate grassland, and mountain areas. Specimens examined: 21.

NOTES. The typical growth form of this species where the narrow, elongated lobes are loosely adnate and have a pale lower surface with moderate to sparse rhizines resembles *Xanthoparmelia elixii*. However, the lobes of *X. elixii* are rarely as elongated, and this lichen contains usnic, norstictic, and salazinic (±) acids. In contrast, the lobes of *X. bungendorensis* are often



Map 14 Distribution of *Xanthoparmelia bungendorensis* in Australia.

sublinear-elongate (greater than 4 mm long), and this species produces usnic acid and the scabrosin metabolites.

Three other species with a pale lower surface and negative chemical reactions, viz., *X. nebulosa, X. spargenosa,* and *X. ustulata*, might be confused with this species. *X. ustulata*, which contains constipatic and protoconstipatic acids, can normally be distinguished by its shorter (less than 3 mm long), narrow, tightly adnate lobes. The morphological distinctions between *X. spargenosa, X. nebulosa*, and *X. bungendorensis* are rather subtle, but the former two species generally have highly imbricate mat-forming lobes reminiscent of *X. tasmanica*, while in *X. bungendorensis* the thallus has a much looser growth habit, commonly with subascending secondary lobes. However, thin-layer chromatography remains the most reliable means of separating these species, since *X. nebulosa* and *X. spargenosa* contain fatty acids rather than the scabrosin derivatives of *X. bungendorensis*. Chemically *X. bungendorensis* is comparable with *X. cravenii* and *X. rupestris*, but *X. cravenii* is clearly distinguished by its tightly adnate thallus and subcrustose growth habit, while the lobes of *X. rupestris* have a brown-black to black lower surface.

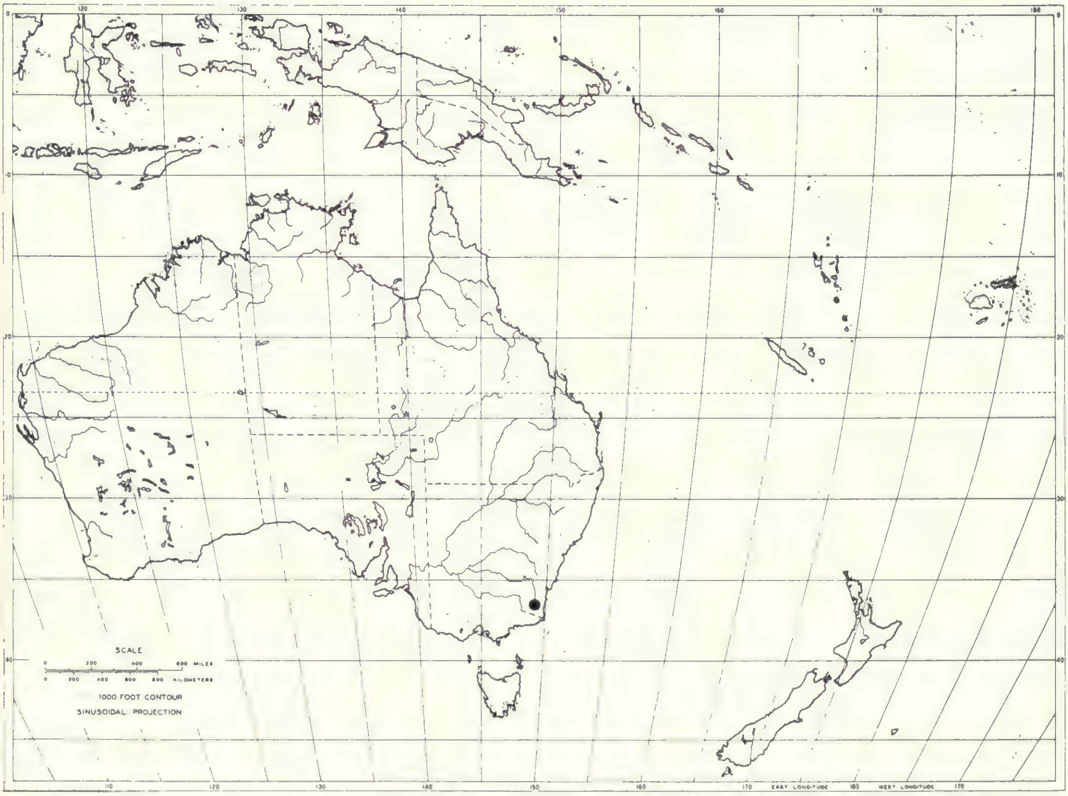
X. bungendorensis is a relatively rare species of scattered distribution, but is generally found on exposed rocks in subarid grasslands where common associates include a variety of species of *Xanthoparmelia* including *X. flavescentireagens, X. subnuda, X. tasmanica,* and *X. elixii*.

15. **Xanthoparmelia burmeisteri** (Elix) Egan

in *Bryologist* **85**: 129 (1982).

≡ *Parmelia burmeisteri* Elix in *Aust. J. Bot.* **24**: 664 (1976). Type: Australia, New South Wales, 10 km south of Nimmitabel, 1156 m, on granite rocks along Snowy Mountains Hwy., *J. A. Elix* 1613 (MEL 1015395! – holotype, CANB! – isotype).

Illustration: Elix (op. cit.).



Map 15 Distribution of *Xanthoparmelia burmeisteri* in Australia.

DESCRIPTION. *Thallus* foliose, loosely adnate on rocks, greenish yellow, subirregularly lobate, 6–8 cm diam., *lobes* imbricate, ± subascending at apices, 0·5–1·5 mm wide. *Upper surface* distinctly to effigurately maculate, often black-margined particularly towards lobe apices, without soredia and isidia; medulla white. *Lower surface* black, rugulose or not, sparsely rhizinate, rhizines black, simple, robust, 0·3–1·5 mm long. *Apothecia* subsessile, 3–7 mm diam., disc dark brown, exciple maculate, margin thick, entire and involute at first, later becoming dentate and cracked; spores 6–8 × 4–5 μm.

CHEMISTRY. Cortex K−; medulla K−, C−, KC+ yellow, P−. Containing usnic acid, barbatic acid (major) and 4-*0*-demethylbarbatic acid (minor).

DISTRIBUTION. Southern tablelands of NSW. Map 15. On rocks in subalpine eucalypt forest. Number of specimens examined: 2.

NOTES. The secondary metabolites produced by this species are comparable with those of *X. barbatica* described above, but *X. burmeisteri* differs morphologically in that the thallus is loosely adnate to rocks, the upper surface of the lobes is maculate, and the lower surface is black. In contrast *X. barbatica* is tightly adnate to rocks, and has an emaculate upper surface and a pale lower surface.

Morphologically this species resembles the *Xanthoparmelia hypoleia* group, which also includes *X. hypoprotocetrarica, X. mannumensis, X. notata,* and *X. pseudohypoleia*. All these lichens have similar moderately to loosely adnate thalli, a maculate upper surface, and a black lower surface. However, the lobes of *X. burmeisteri* are subascending at the apices and are crenate along the margin, and this species has a restricted geographical distribution. This group of species can be conveniently distinguished chemically as outlined in the key detailed under *X. hypoleia*.

16. **Xanthoparmelia centralis** Elix & Jen Johnston, **sp. nov.**

Thallus ut in *Xanthoparmelia weberi* sed lobis angustioribus et acidum barbaticum, acidum 4-*0*-demethylbarbaticum et acidum 3-α-hydroxybarbaticum continenti differt. Superficies superior isidiata, isidiis globosis demum ad apices inflatis, apicibus demum erumpentibus. Superficies inferior pallidobrunnea, modice rhizinata, rhizinis simplicibus concoloribus. Thallus 105–155 μm crassus; cortex superior 17–21 μm crassus, stratum gonidiale 20–28 μm crassum, medulla 50–105 μm crassa, cortex inferior 7–14 μm crassus. Thallus K−; medulla K−, C−, KC+ flavescens, P−.

Type: Australia, Northern Territory, Liddle Hills, 13 km north of Angas Downs Homestead, on sandstone rocks, 10 September 1983, *J. A. Elix* 11172 & *L. A. Craven* (CBG! – holotype).
Illustration: Fig. 7.

DESCRIPTION. *Thallus* foliose, moderately to tightly adnate on rocks, yellow-green to darkish olive-green with age, 3–5 cm diam.; *lobes* irregular, imbricate or not, 0·5–1·5(–2·0) mm wide, older lobes becoming areolate. *Upper surface* dull for the most part, shiny near apices, emaculate, becoming rugose and areolate in older lobes, isidiate, *isidia* globose or short cylindrical, simple at first but expanding laterally and becoming sparingly branched, ultimately the apices becoming inflated and rarely erumpent, not at all sorediose. *Lower surface* pale tan to light brown, darker blackish-brown at apices, shiny, moderately rhizinate, rhizines simple, slender, ± elongated to 0·8 mm long, concolorous with the lower surface. *Apothecia* not seen.

CHEMISTRY. Thallus K−; medulla K−, C−, P−, KC+ yellow; containing usnic acid, barbatic acid (major), 4-*0*-demethylbarbatic acid and 3-α-hydroxybarbatic acid.

DISTRIBUTION. Central Australia (southern NT). Map 16. On rocks in arid areas. Specimens examined: 3.

NOTES. This species is characterised by the isidiate upper surface, the pale lower surface, and the production of barbatic acid and 4-*0*-demethylbarbatic acid in the medulla.

Morphologically *X. centralis* closely resembles *X. flindersiana* and *X. weberi*, as all three species have tightly adnate thalli, a pale brown lower surface, and produce inflated, ± erumpent

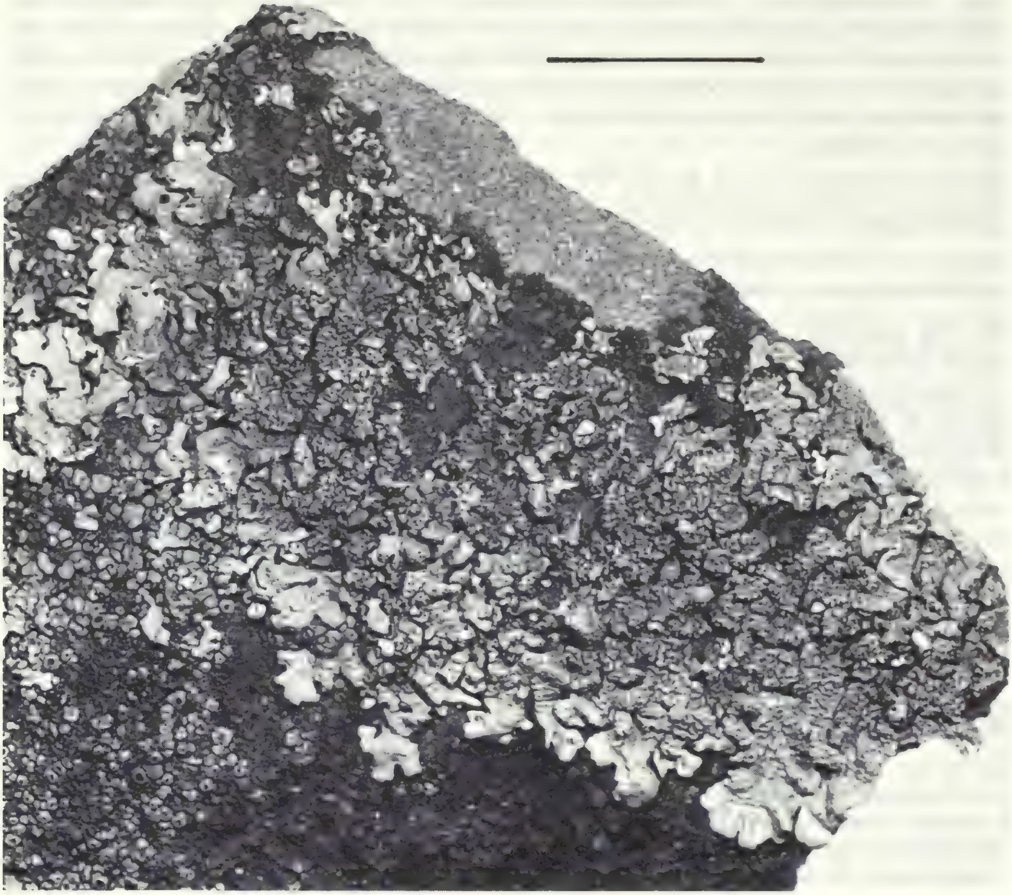


Fig. 7 *Xanthoparmelia centralis* Elix & Jen Johnston. Portion of holotype in CBG. Scale = 1 cm.

isidia. However *X. weberi* and *X. flindersiana* generally have somewhat broader lobes (1·0–3·0 mm) and *X. weberi* is densely isidiate, while *X. centralis* has narrower lobes (0·8–1·5 mm) and has scattered isidia. Even so, these species can be most reliably distinguished chemically since the medulla of *X. flindersiana* reacts K+ yellow-red (norstictic acid), *X. centralis* reacts K−, KC+ yellow (barbatic acid) and *X. weberi* K−, KC− (hypoprotocetraric acid).

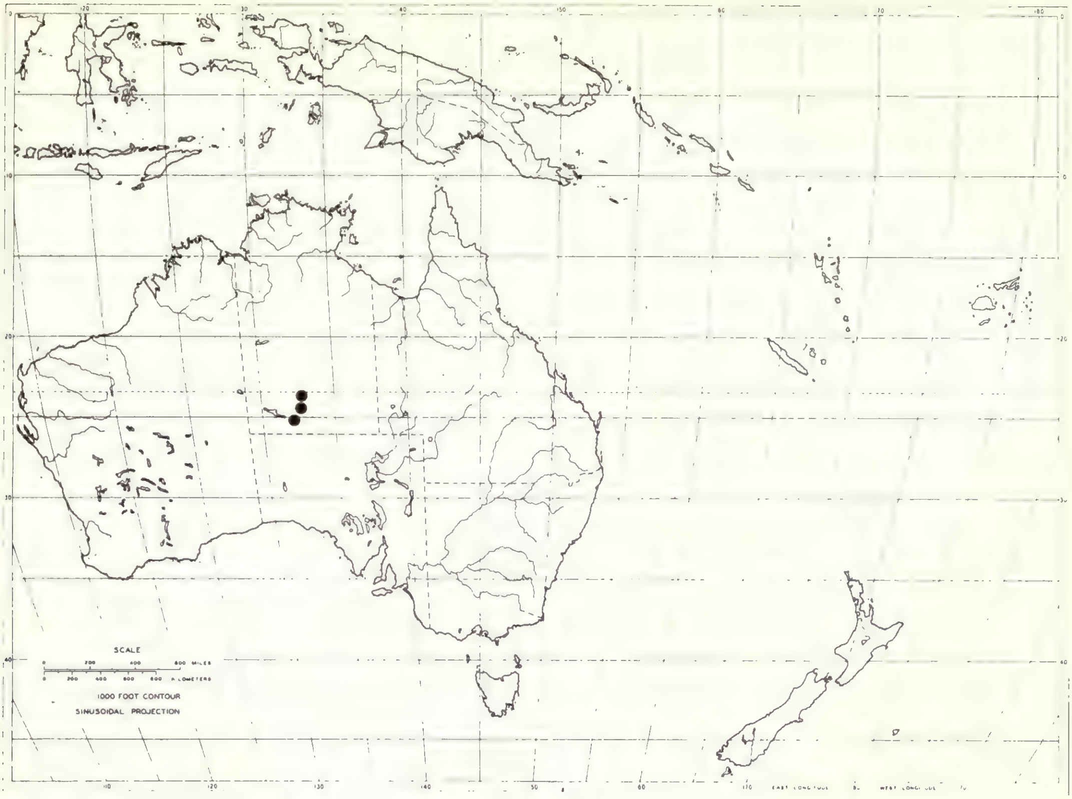
X. centralis also resembles the North American species *X. moctezumensis* Nash, as these two species have similar chemical profiles and morphology. The latter species differs in having cylindrical – coralloid isidia and producing 3-α-hydroxybarbatic acid as the major secondary metabolite (Culberson, Nash & Johnson, 1979).

X. centralis is a rare species in Australia and has only been collected from the MacDonnell Ranges and areas near Alice Springs. Here it was found growing on rocks with a southerly aspect together with *Acarospora schleicheri* (Ach.) Massal. and other species of *Xanthoparmelia* including *X. cravenii, X. subdomokosii*, and *X. weberi*.

17. **Xanthoparmelia cheelii** (Gyelnik) Hale

in *Phytologia* **28**: 486 (1974).

≡ *Parmelia cheelii* Gyelnik in *Ann. Mycol.* **36**: 271 (1938). Type: Australia, New South Wales, Goulburn, rocky hill, 18 April 1908, *Edwin Cheel* (BP! – holotype).



Map 16 Distribution of *Xanthoparmelia centralis* in Australia.

= *Parmelia conspersa* var. *nigromarginata* Stirton in *Trans. N.Z. Inst.* **32**: 78 (1900). Type: Australia, Victoria, Tumbo River, Gippsland, *Mr Lucas* (BM! – holotype).
Illustration: Fig. 8.

DESCRIPTION. *Thallus* foliose, saxicolous, loosely attached to substrate, yellow-green, 5–10 cm diam.; *lobes* sublinear-elongate, subdichotomously divided, 0·5–1·0(–1·5) mm wide, plane, very densely imbricate building up thallus into a thick mat. *Upper surface* smooth, shiny, emaculate, margin blackened especially towards apices, lacking soredia and isidia; medulla white. *Lower surface* jet black, smooth, brown-black near lobe apices, very sparsely rhizinate, the rhizines simple, black, very short and robust. *Apothecia* to 7 mm diam., deeply concave; disc reddish-brown, margin persistent; spores 10–11 × 6–7 μm.

CHEMISTRY. Thallus K−; medulla K+ yellow becoming deep red, C−, KC−, P+ orange-red; containing usnic acid, salazinic acid, and consalazinic acid.

DISTRIBUTION. Southern Australia. (WA, NSW, ACT, Vic, Tas, SA) and South Island, New Zealand. Map 17. On rocks in montane, hinterland, and coastal zones with moderate rainfall. Number of specimens examined: 32.

NOTES. This species resembles *X. tasmanica* in some respects as both have thalli composed of densely imbricate lobes which form a thick mat, and contain usnic and salazinic acids. However the lobes of *X. cheelii* are narrow (0·5–1·0 mm wide) and subdichotomously divided, while those of *X. tasmanica* are broader (1·0–3·0 mm) and subirregularly divided. Occasionally these species do tend to intergrade and some lichenologists consider that *X. cheelii* is really just an extreme growth form of *X. tasmanica*.

X. cheelii also resembles *X. eradicata* in that both species have linear-elongate lobes which

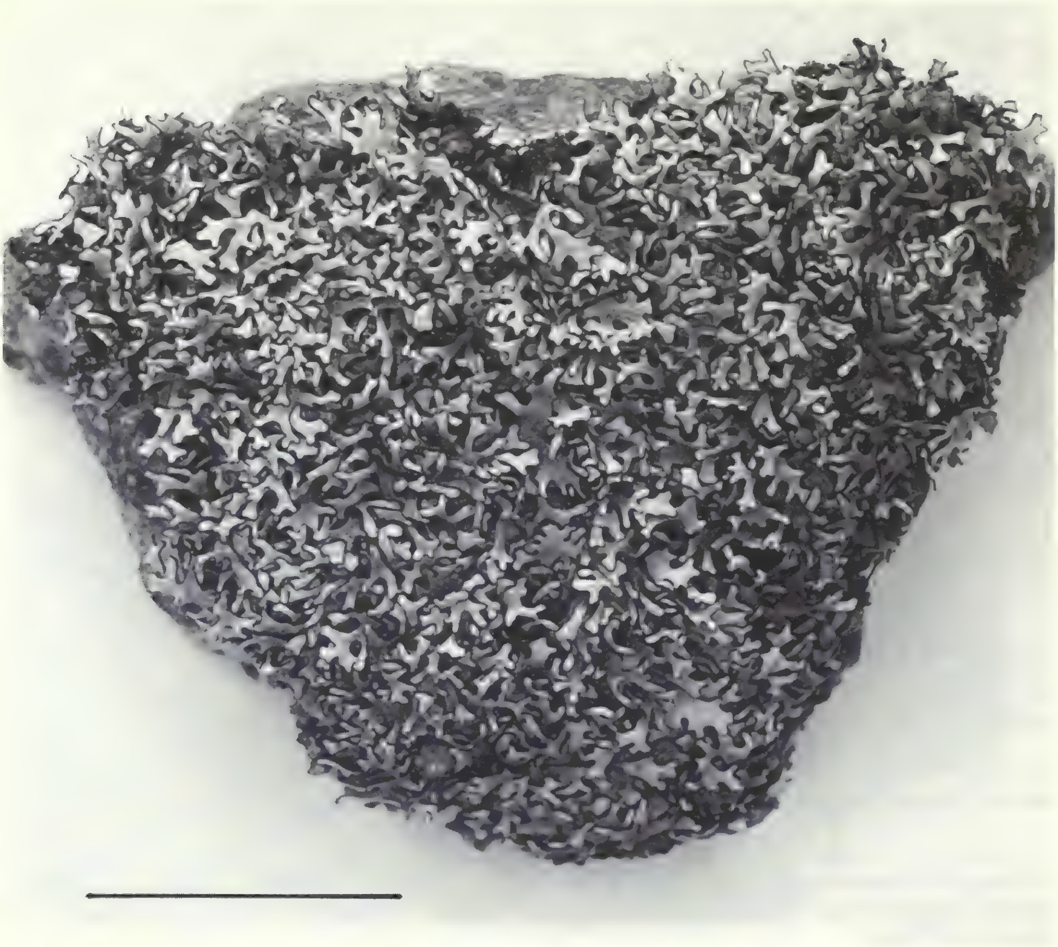


Fig. 8 *Xanthoparmelia cheelii* (Gyelnik) Hale. *Elix* 1947 in ANUC. Scale = 1 cm.

exhibit subdichotomous branching. However, the lobes of *X. eradicata* are much more elongated, do not form a thick mat of thallus, are usually ascending or subascending at the apices, and commonly contain traces of accessory norstictic acid in addition to salazinic acid. In *X. cheelii* the lobes are flat and densely imbricate and contain only salazinic acid and consalazinic acid in the medulla. Further, the lower surface of the lobes is usually rugulose in *X. eradicata* but smooth in *X. cheelii*. *X. cheelii* is considered to belong to the *X. subnuda* group of species, a key to which is given under *Xanthoparmelia subnuda*.

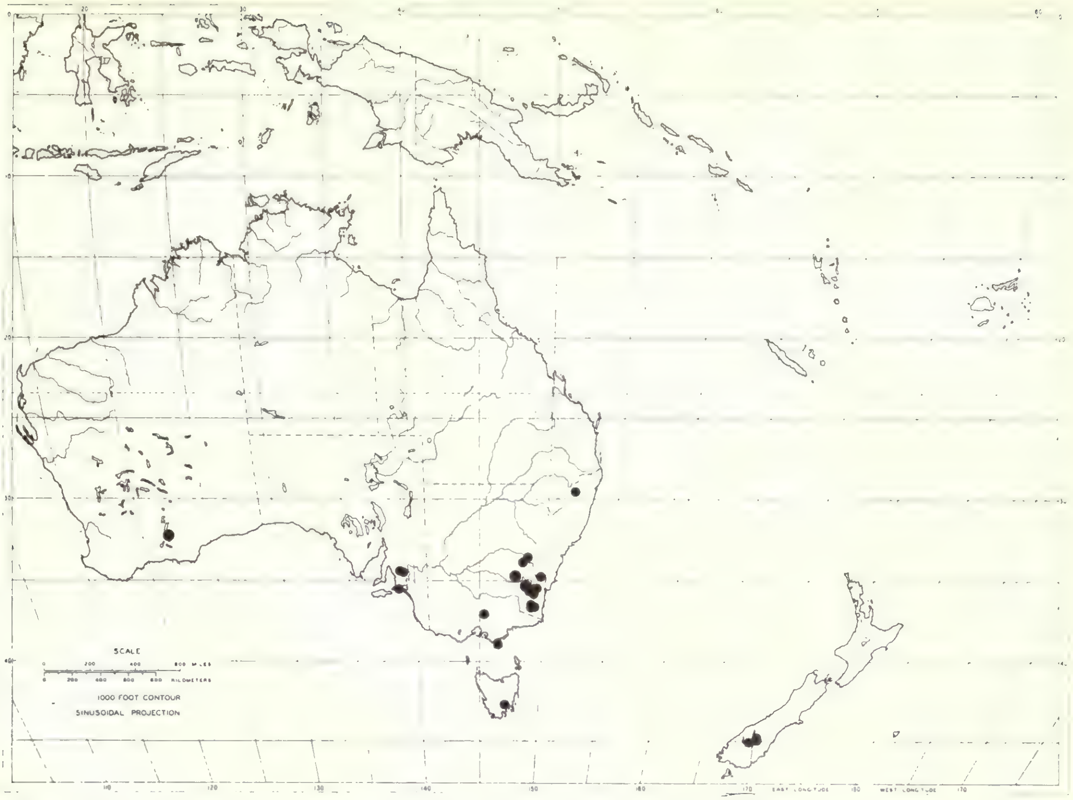
X. cheelii is scattered on rocks in open areas throughout southern Australia and New Zealand.

18. **Xanthoparmelia concomitans** Elix & Jen Johnston, **sp. nov.**

Thallus ut in *Xanthoparmelia reptanti* sed superficie superiore ad apicem loborum sorediata differt. Thallus 300–390 μm crassus; cortex superior 35–45 μm crassus, stratum gonidiale non-continuum 25–35 μm crassum, medulla 245–280 μm crassa, cortex inferior 10–14 μm crassus. Thallus K−; medulla K+ brunnescens, C−, P+ aurantiaco-rubescens, acidum usnicum et acidum fumarprotocetraricum et acidum succinprotocetraricum continens.

Type: New Zealand, Otago, Alexandra, 0·5 km beyond Lookout, on silty soils, 11 April 1971, *W. Martin* (CHR 343817 pr. p.! – holotype).

Illustration: Fig. 9.



Map 17 Distribution of *Xanthoparmelia cheelii* in Australia and New Zealand.

Description. *Thallus* foliose, loose or loosely adnate on soil, pale yellow to pale yellow-green, forming rosettes 0·5–2 cm diam.; *lobes* sublinear-elongate, subdichotomously to dichotomously branched, imbricate or not, ± separated near the margin of thallus, 0·2–1·0(–2·0) mm wide. *Upper surface* dull, ± maculate, weakly convex, sorediate, lobe apices (rarely the margins) becoming swollen and developing terminal, subcapitate soralia, the soredia farinose; lacking isidia; medulla white. *Lower surface* canaliculate in part, pale yellow to yellow-brown, sparsely to moderately rhizinate, the rhizines black, simple or rarely sparsely branched. *Apothecia* not seen.

Chemistry. Cortex K−; medulla K+ brown, C−, P+ orange-red; containing usnic acid, fumarprotocetraric acid, succinprotocetraric acid (±), traces of protocetraric acid (±).

Distribution. Victoria (Murray mallee), south-west WA, and South Island, New Zealand. Map 18. On soil in dry subalpine and subarid grasslands. Specimens examined: 24.

Notes. This characteristic species is distinguished by the presence of soredia and the convex, dichotomously branched lobes with a canaliculate lower surface. Morphologically it closely resembles *X. reptans* and, indeed, has generally been collected admixed with the latter species. As these two species are chemically identical, *X. concomitans* is considered the sorediate counterpart of *X. reptans*.

X. concomitans is morphologically comparable with *X. aurifera*, although they can be readily separated chemically. Thus *X. aurifera* contains the stictic acid complex, while *X. concomitans* contains fumarprotocetraric acid and succinprotocetraric acid. A similar rationale can be forwarded for maintaining these chemical races as distinct species as that argued for distinguishing *X. amphixantha* and *X. reptans*.

X. concomitans appears to be very rare in Australia (only two collections examined) but

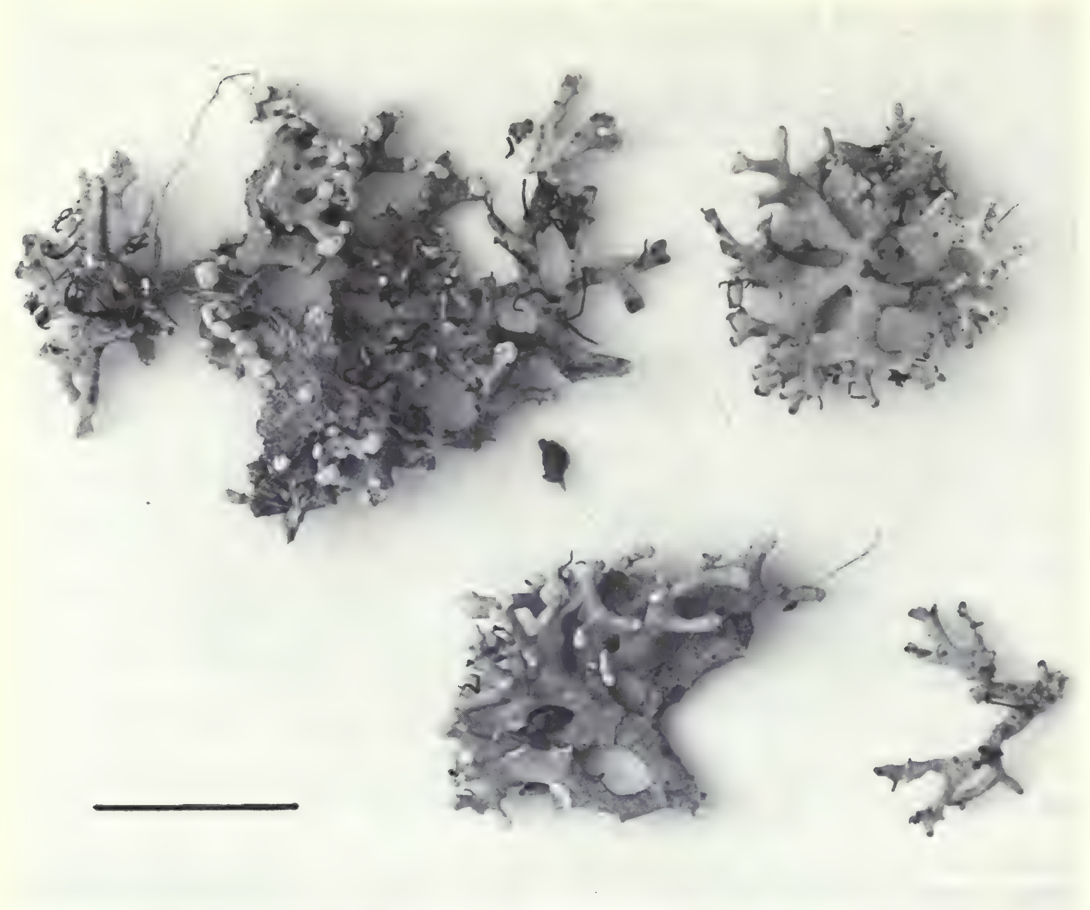


Fig. 9 *Xanthoparmelia concomitans* Elix & Jen Johnston. Holotype in CHR. Scale = 0·5 cm.

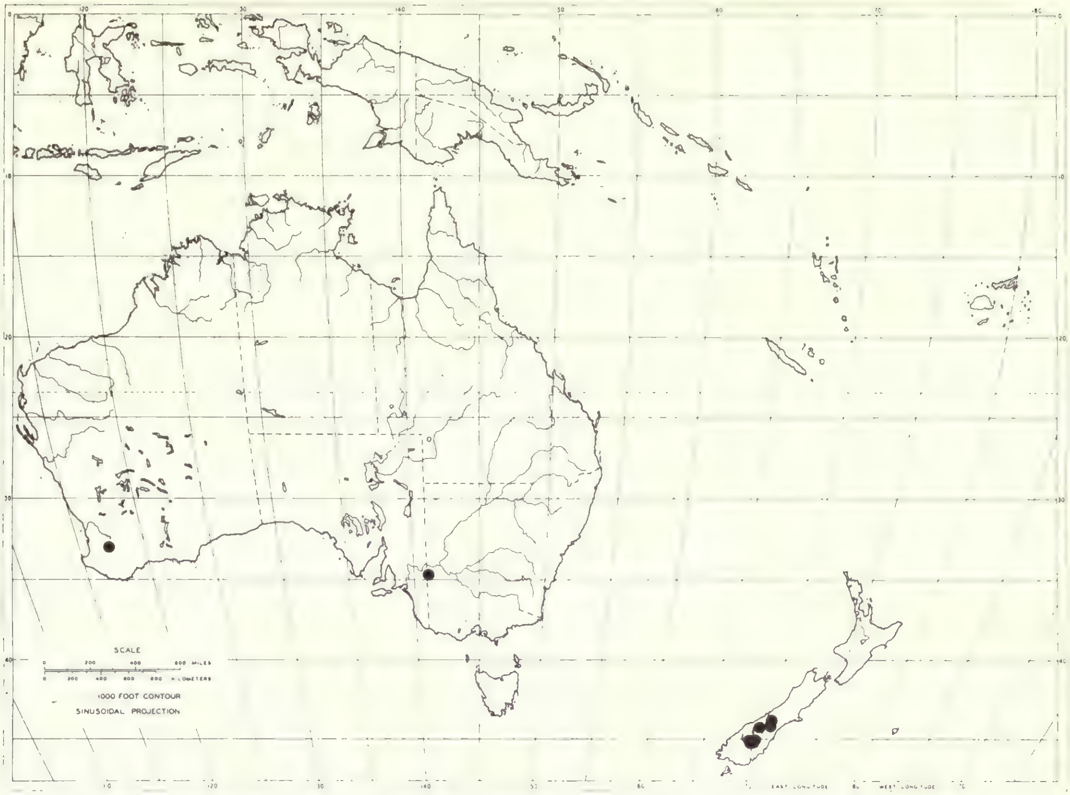
common in New Zealand. There this species is found in semi-arid areas of induced steppe in the South Island (Central Otago, north Canterbury, and Marlborough) where it associates with *Chondropsis semiviridis* (Nyl.) Nyl., *Cladia aggregata* (Swartz) Nyl., *X. reptans, X. molliuscula,* and *X. substrigosa*.

19. Xanthoparmelia congesta (Kurok. & Filson) Elix & Jen Johnston, comb. nov.

Basionym: *Parmelia congesta* Kurok. & Filson in *Bull. natn. Sci. Mus. Tokyo* B, **1**: 36 (1975). Type: Australia, South Australia, Podinna Rock, 24 km north of Minnipa, growing on granite, *R. Filson* 11901c (MEL 1011861! – holotype).

Illustrations: Kurokawa & Filson (op. cit.). Filson & Rogers, *Lichens South Australia*: plate 11B (1979).

Description. *Thallus* foliose, adnate, yellow to yellow-green, 7–10 cm diam.; *lobes* irregular, ± contiguous, for the most part imbricate but not ascending, 0·7–3·0(–7·0) mm wide. *Upper surface* slightly glossy or opaque, becoming rugose and ridged or areolate in older, central parts, commonly black at margins, lacking soredia and isidia; medulla white. *Lower surface* black, rugulose or not, sparsely rhizinate, rhizines black, simple, robust, *c.* 0·2 mm long. *Apothecia* substipitate, 3–9 mm in diameter, margins involute and undulate at first, ultimately developing subradiating fissures, disc red-brown to black-brown; spores 6–8 × 4–5·5 μm.



Map 18 Distribution of *Xanthoparmelia concomitans* in Australia and New Zealand.

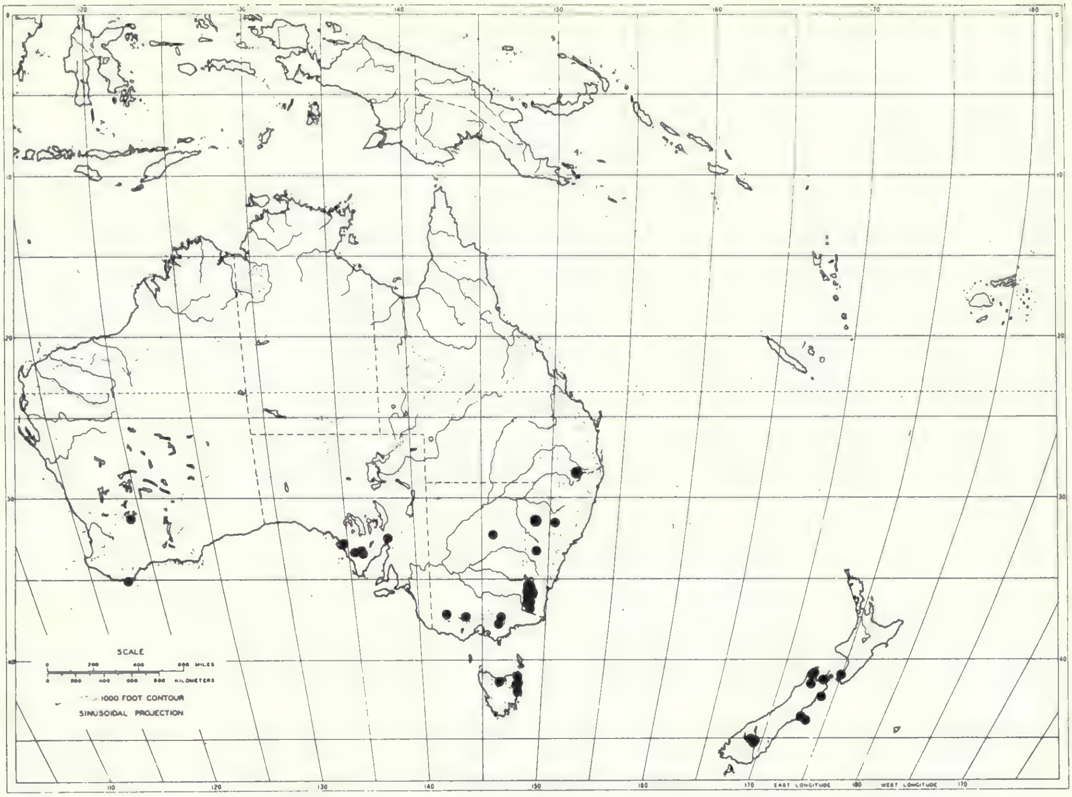
CHEMISTRY. Cortex K−; medulla K+ yellow becoming orange-red, C−, P+ yellow. Containing usnic acid, norstictic acid, trace of connorstictic acid, trace of salazinic acid (±).

DISTRIBUTION. Scattered in dry areas of Qld, NSW SA, WA, and common in the alpine and subalpine areas of NSW, ACT, Vic, Tas, and South Island, New Zealand. Map 19. On exposed rocks. Specimens examined: 64.

NOTES. This species resembles *X. tasmanica* and *X. luminosa* in often forming a thick mat composed of imbricate lobes with a black lower surface. However, the thallus of *X. congesta* is more tightly adnate than it is in *X. tasmanica*, as is clearly distinguished from *X. luminosa* by the lack of the orange pigment skyrin in the lower medulla. Further, both *X. tasmanica* and *X. luminosa* produce usnic and salazinic acids, whereas norstictic acid is the major metabolite of *X. congesta*.

X. glareosa, which resembles *X. congesta* in chemistry and the black lower surface, may be confused with this species. While *X. congesta* has broad, irregular, tightly adnate lobes which are crowded to contiguous, *X. glareosa* has subdivergent, elongated lobes which are moderately to loosely adnate, and commonly develops subdichotomously divided secondary lobes in the centre of the thallus. Further, the lower surface of *X. congesta* is sparsely rhizinate, and the rhizines simple, while *X. glareosa* is moderately rhizinate with subapically grouped commonly dichotomous rhizines. The spores of *X. glareosa* (10–12 × 5–6 μm) are also a little larger than those of *X. congesta* (6–8 × 4–5 μm).

X. congesta is rare on rocks in subarid areas but relatively common on exposed, subalpine rocks. Here common associates include *Cladia aggregata* (Swartz) Nyl., *Parmelia signifera* Nyl., and other species of *Xanthoparmelia* including *X. tegeta, X. cordillerana,* and *X. flavescentireagens*.



Map 19 Distribution of *Xanthoparmelia congesta* in Australia and New Zealand.

20. **Xanthoparmelia consociata** (Elix) Elix & Jen Johnston, **comb. nov.**

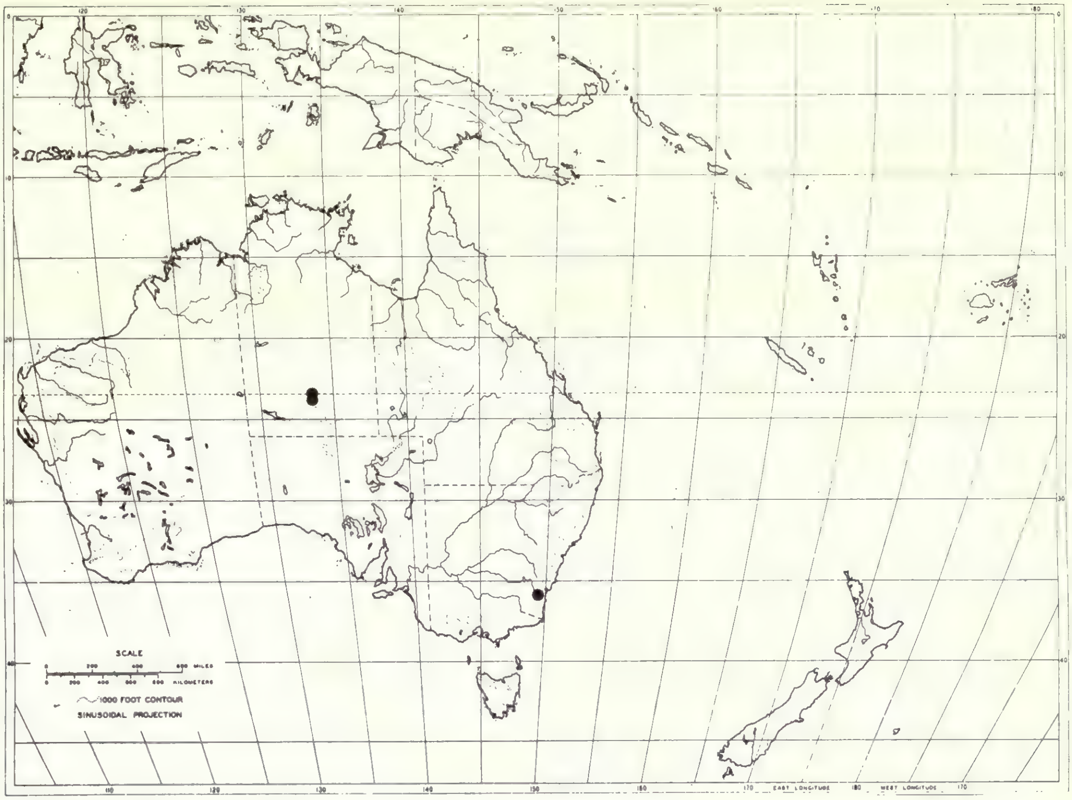
Basionym: *Parmelia consociata* Elix in *Aust. J. Bot.* **29**: 352 (1981). Type: Australia, Australian Capital Territory, 1·5 km south-west of Glendale Crossing, 1100 m, on granite rocks, *J. A. Elix* 3142 (MEL! – holotype; CANB! – isotype).
Illustration: Elix (op. cit.).

DESCRIPTION. *Thallus* small-foliose to subcrustose, tightly appressed on rocks, greenish-yellow, subirregularly lobate or becoming almost subcrustose towards centre, 3–6 cm diam.; *lobes* sublinear, contiguous, 0·3–1·0 mm wide, older lobes irregularly fractured and areolae commonly formed. *Upper surface* opaque, emaculate, often tangentially cracked, moderately to sparsely isidiate, *isidia* cylindrical, mainly simple; medulla white. *Lower surface* pale brown to brown but often straw-yellow near lobe apices, moderately rhizinate, rhizines simple, pale brown. *Apothecia* adnate, 0·5–1·0 mm diam., disc dark brown, exciple smooth, isidiate; spores 6–9 × 3·5–5·5 μm.

CHEMISTRY. Thallus K−; medulla K+ yellow then red, C−, CK−, P+ intense yellow; containing usnic acid, salazinic acid (major), norstictic acid, and (±) consalazinic acid.

DISTRIBUTION. Southern tablelands of NSW, ACT, and in central Australia (NT). Map 20. On rocks in subalpine eucalypt forests and arid areas. Specimens examined: 9.

NOTES. Morphologically this species closely resembles *X. mougeotina* in that both lichens have tightly adnate thalli, contiguous lobes, and isidia. However, *X. mougeotina* has a dark brown to black lower surface and contains usnic acid, stictic acid, constictic acid, and traces of norstictic acid, while *X. consociata* has a pale lower surface and contains usnic acid, salazinic acid, and norstictic acid.



Map 20 Distribution of *Xanthoparmelia consociata* in Australia.

X. consociata may be confused with *X. antleriformis*, but the former species can be distinguished by the thallus being more tightly adnate, the lobes contiguous, and the moderate to sparse isidia being simple or sparsely branched. In *X. antleriformis* the thallus is only moderately adnate, the lobes are stellate and commonly radiating and the dense isidia are generally extensively branched. So far *X. antleriformis* has not been found to contain both salazinic acid and norstictic acid in substantial quantities, as does *X. consociata*.

X. exillima, another subcrustose, isidiate species with contiguous lobes, is also distinguished by the branched isidia and the chemistry. This species reacts KC+ rose and produces usnic acid and norlobaridone.

X. consociata is a rare species most commonly associated with *X. mougeotina, Lecidea aspidula* Krempelh., and *Parmelia signifera* Nyl., on subalpine rocks, or *Xanthoparmelia cravenii* and *X. scabrosa* on arid rocks.

21. **Xanthoparmelia constipata** (Kurok. & Filson) Elix & Jen Johnston, **comb. nov.**

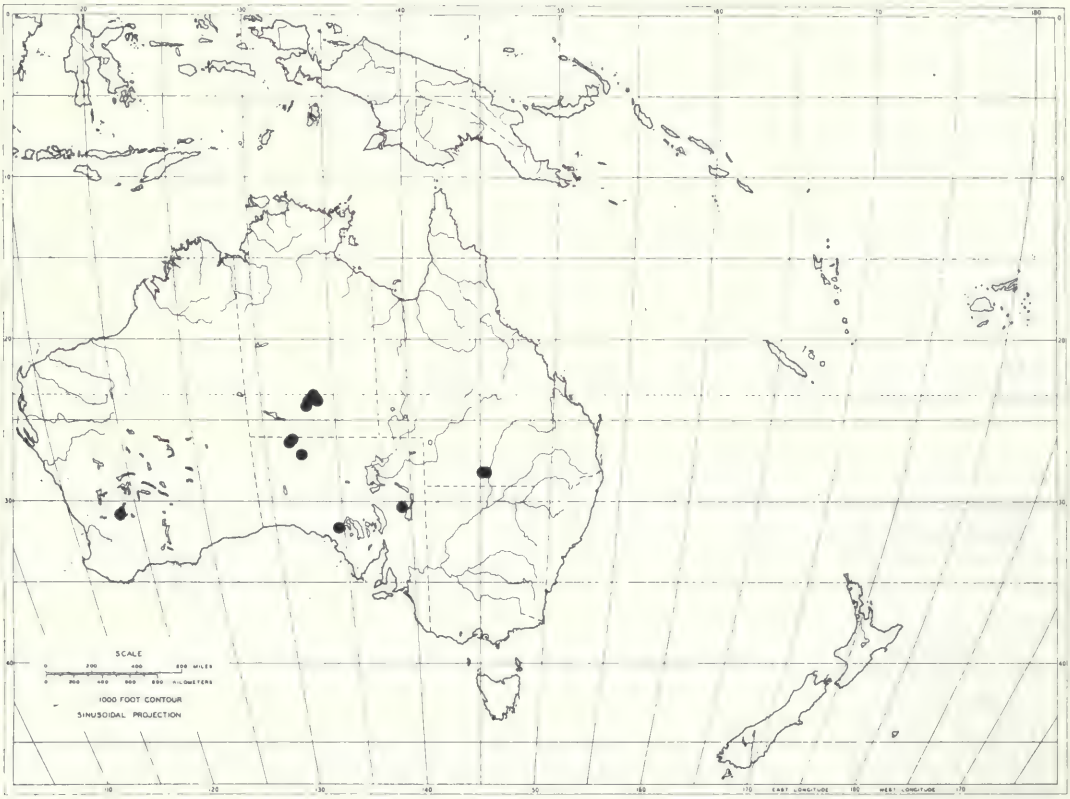
Basionym: *Parmelia constipata* Kurok. & Filson in *Bull. natn. Sci. Mus. Tokyo* B, **1**: 37 (1975). Type: Australia, South Australia, Koonamore Vegetation Reserve, on soil, May 1971, *R. W. Seppelt* (MEL 1013410! – holotype).

Illustration: Kurokawa & Filson (op. cit.).

DESCRIPTION. *Thallus* foliose, terricolous, adnate to the substrate, pale yellow to yellowish-green, subirregularly lobate, 4–5(–7) cm diam.; *lobes* subirregular to sublinear-elongate, sometimes imbricate, marginal lobes broader and somewhat flattened, 1–2(–3) mm wide, sometimes developing narrower secondary lobes towards centre of thallus, 0·5–1·0 mm wide. *Upper surface* dull or sometimes shiny towards apices, emaculate, slightly rugulose, often black-margined towards lobe apices, lacking soredia but densely isidiose, *isidia* cylindrical, robust (0·2 mm wide), extensively branched, coralloid or ± lobulate, to 2 mm high ultimately inflated at apices and becoming erumpent; medulla white. *Lower surface* pale brown, darker towards lobe apices, moderately to sparsely rhizinate, rhizines simple, concolorous with lower surface. Apothecia immature, substipitate, to 1 mm diam., with a thick, isidiate involute margin.

CHEMISTRY. Thallus K−, medulla K−, C−, KC+ rose, P−; containing usnic acid, loxodin (±), norloboridone, constipatic acid, protoconstipatic acid, scabrosin 4-acetate-4′-butyrate (±), scabrosin 4-acetate-4′-hexanoate (±), scabrosin 4,4′-dibutyrate (±), scabrosin 4,4′-diacetate (± trace).

DISTRIBUTION. Inland Qld, SA, WA, and southern NT. Map 21. On soil, rarely spreading to rocks in arid and subarid areas. Specimens examined: 20.



Map 21 Distribution of *Xanthoparmelia constipata* in Australia.

NOTES. *X. constipata* is a member of the *X. scabrosa* complex and resembles *X. scabrosa*, the common saxicolous species with erumpent isidia.

X. constipata is clearly distinguished from *X. scabrosa* by the more robust isidia (which are sometimes flattened-expanded towards the apices and sublobulate in appearance), the thicker thallus and invariably the presence of constipatic acid and protoconstipatic acid in addition to loxodin and norlobaridone. Its substrate preference is also different. For further discussion of the *X. scabrosa* complex see under *X. amplexula*.

This is a rather rare terricolous species which occurs in arid, inland Western Australia, South Australia, and Northern Territory.

22. **Xanthoparmelia constrictans** (Nyl. ex Crombie) Hale

in *Phytologia* **28**: 486 (1974).

≡ *Parmelia constrictans* Nyl. ex Crombie in *J. Bot. Lond.* **14**: 19 (1876). Type: South Africa, Cape of Good Hope, Table Mountain, on the ground towards the summit, apparently amongst detritus, October 1874, *A. E. Eaton* (Venus Transit Expedition) (BM! – lectotype and isolectotypes).

Illustration: Fig. 10.

DESCRIPTION. *Thallus* foliose, moderately to loosely adnate to rocks or soil, yellow-green darkening with age, 5–7 cm diam.; *lobes* linear-elongate, dichotomously to subdichotomously branched, moderately to sparingly imbricate, 0·4–1·5 mm wide but often irregularly widened

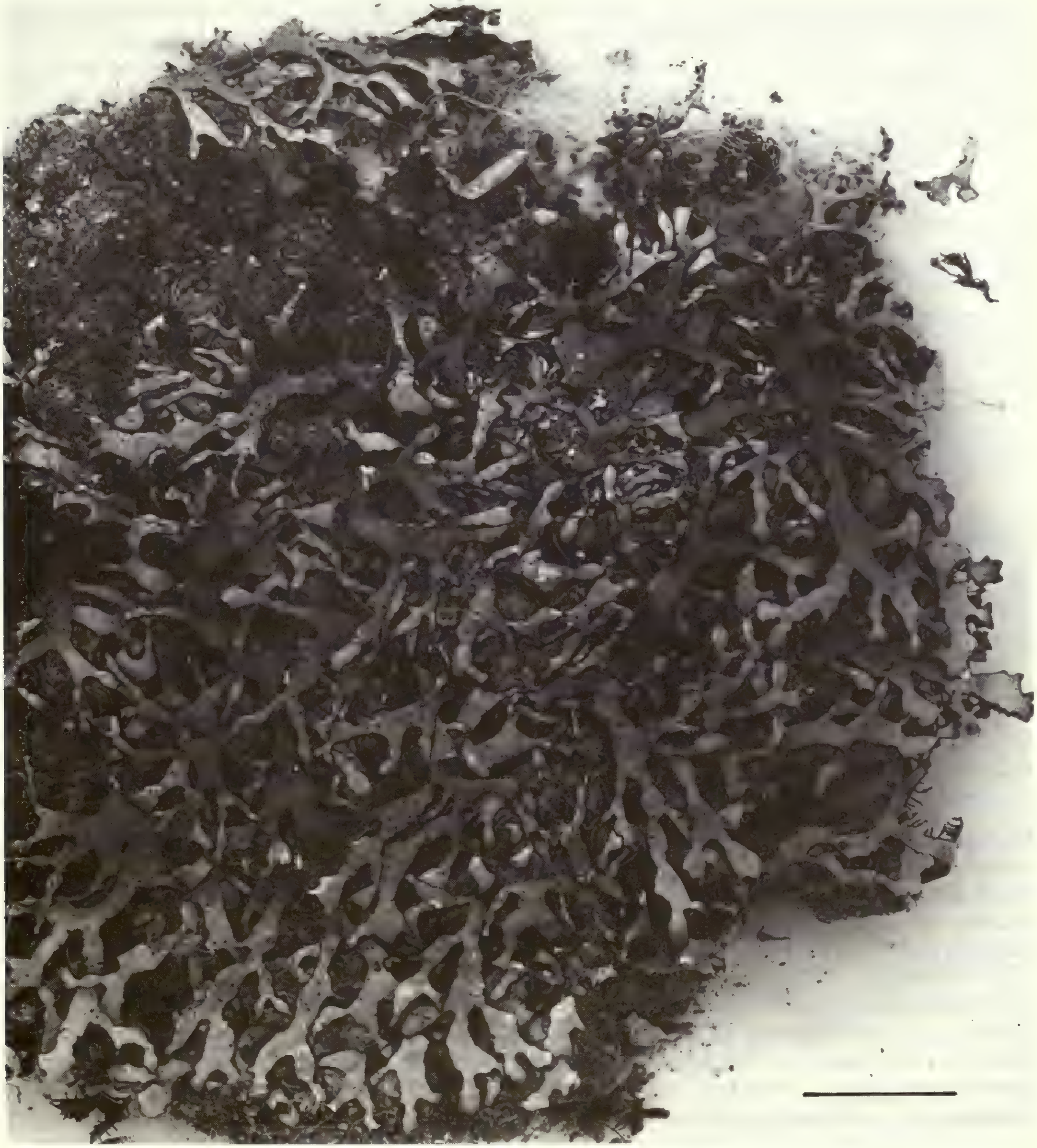
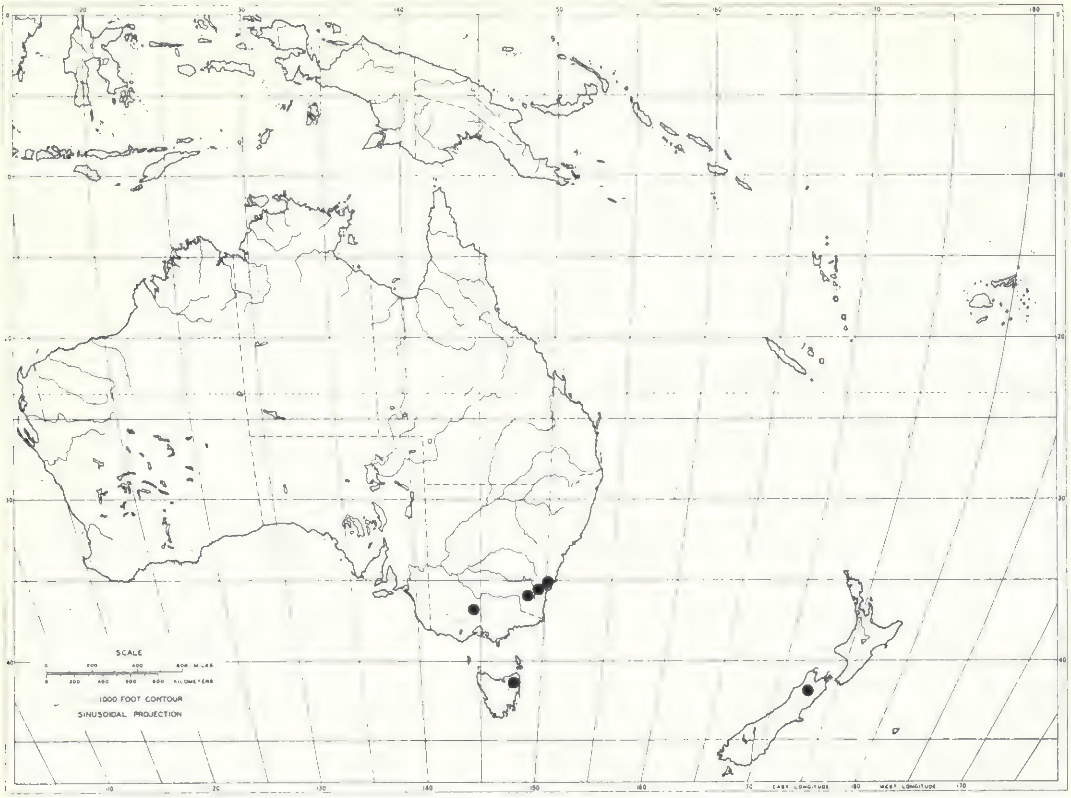


Fig. 10 *Xanthoparmelia constrictans* (Nyl.) Hale. Isotype in BM. Scale = 1 cm.

and constricted. *Upper surface* smooth, shiny, emaculate, lacking soredia and isidia but with numerous pycnidia, margins black; medulla white. *Lower surface* jet black but brown at tips of lobes, densely to moderately rhizinate, rhizines simple or tufted, often curved and projecting beyond lobe margin. *Apothecia* not seen.

CHEMISTRY. Thallus K−; medulla K+ yellow becoming deep red, C−, P+ orange; containing usnic acid, salazinic acid, and consalazinic acid.

DISTRIBUTION. South-eastern Australia (NSW, Vic, Tas) and South Island, New Zealand. Map 22. Also in South Africa. On rocks in hilly, montane, and subalpine forests. Specimens examined: 6.



Map 22 Distribution of *Xanthoparmelia constrictans* in Australia and New Zealand.

NOTES: *Xanthoparmelia constrictans* is distinguished by the loosely imbricate, linear-elongate lobes, which are irregularly constricted, and the production of salazinic acid in the medulla. *X. tegeta* has a similar morphology, but is distinguished in its typical growth form where the lobes become densely imbricate and compacted, forming a thick mat of thallus. Moreoever, *X. tegeta* contains the stictic acid complex rather than salazinic acid.

Chemically *X. constrictans* is identical with *X. eradicata* – a morphologically similar species which also occurs in both South Africa and south-eastern Australia. Lobes of *X. eradicata* tend to be much more uniform in width (i.e. not irregularly constricted), but this species differs mainly in the nature of the lower surface, which is sparsely rhizinate and often erhizinate towards the apices, wrinkled, with short, robust, and ± tufted rhizines. By contrast *X. contrictans* is moderately to densely rhizinate, with ± subapically grouped rhizines; the long, ± branched, curved rhizines commonly projecting beyond the lobe margins.

X. constrictans is a rare species in Australia being restricted to the mountains of south-eastern

Australia and Tasmania. Here it often occurs with *Cladia aggregata* (Swartz) Nyl. and many other species of *Xanthoparmelia* including *X. tegeta, X. eradicata, X. substrigosa,* and *X. tasmanica*.

23. **Xanthoparmelia convoluta** (Krempelh.) Hale

in *Phytologia* **28**: 487 (1974).

≡ *Parmelia convoluta* Krempelh. in *Verh. zool.-bot. Ges. Wien* **30**: 337 (1880). Type: Australia, central Australia, *E. Giles* (M! – holotype).

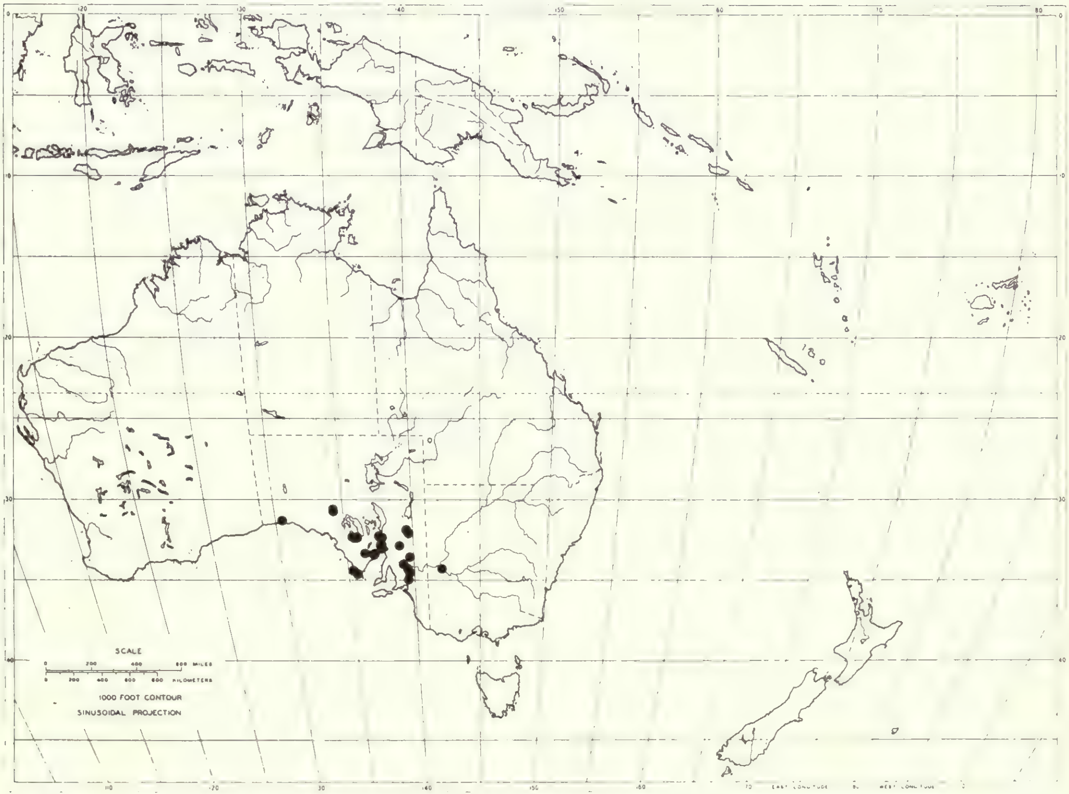
Illustration: Filson & Rogers, *Lichens South Australia*: fig. 22 B (1979).

DESCRIPTION. *Thallus* foliose, unattached on soil, pale yellow-green, darkening in older central lobes, 2–6 cm diam.; *lobes* elongate, convolute, contorted, 3·5–8·0 mm broad when flattened, 1·0–4·0 mm wide when dry and convoluted. *Upper surface* smooth, emaculate, becoming rugulose and cracked in older lobes, soredia and isidia absent, marginal and laminal lobules sometimes present in older lobes. *Lower surface* pale to dark brown, very sparsely rhizinate, rhizines simple, concolorous with lower surface. *Apothecia* rare, shortly stipitate, concave, to 4 mm diam., disc dark brown, margin thick, crenulate, incised, markedly involute at first, then less so; spores 10–11 × 6 μm.

CHEMISTRY. Thallus K−; medulla K+ yellow becoming red, C−, P+ orange; containing usnic acid, salazinic acid, and consalazinic acid.

DISTRIBUTION. Drier areas of southern SA and western Vic. Map 23. On bare earth in mallee scrub. Specimens examined: 38.

NOTES. This species with its characteristic convolute, highly contorted lobes, closely resembles



Map 23 Distribution of *Xanthoparmelia convoluta* in Australia.

X. australiensis and *X. norconvoluta* and can only reliably be distinguished from them by chemical means. For further discussion see under *X. australiensis*.

The terricolous lichen community with which *X. convoluta* is commonly associated includes *Psora decipiens* (Hedwig) Hoffm., *Chondropsis semiviridis* (Nyl.) Nyl., *Diploschistes* sp., and *Xanthoparmelia pumila*.

24. **Xanthoparmelia cordillerana** (Gyelnik) Hale

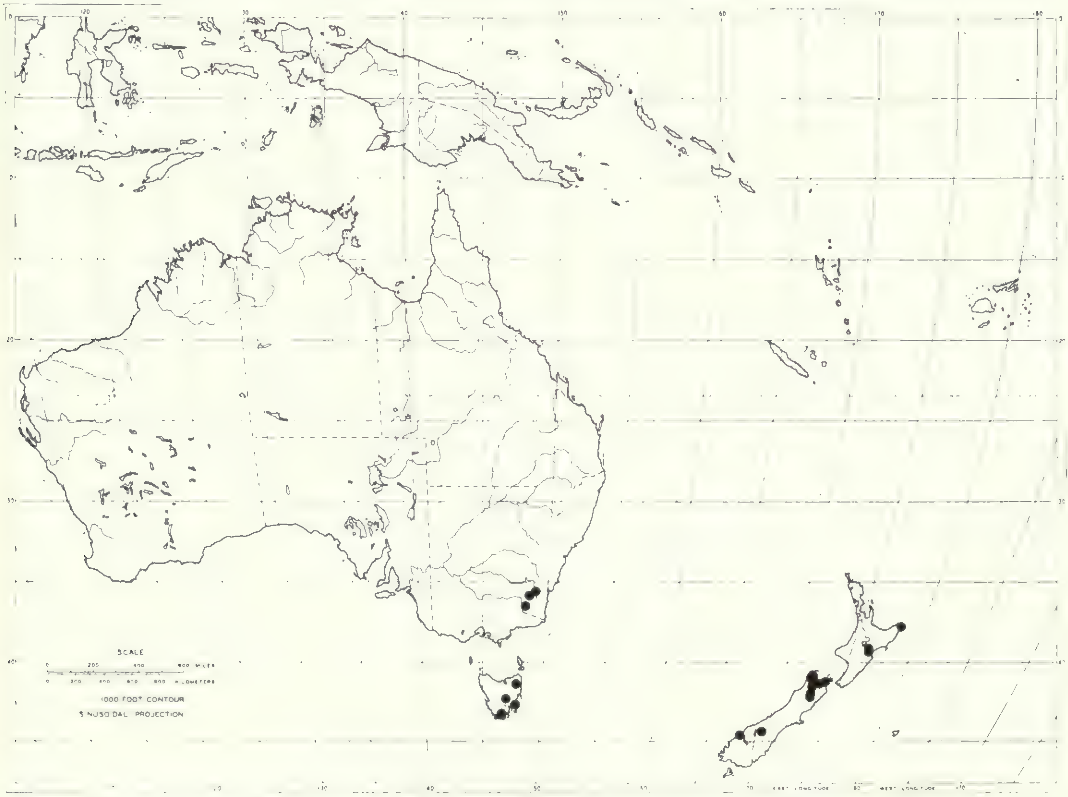
in *Phytologia* **28**: 487 (1974).

≡ *Parmelia cordillerana* Gyelnik in *Ann. Mycol.* **36**: 276 (1938). Type: Peru, Dept. de Libertad, Hacienda d'Anasmurca, au pied de la Cordillère Occidentale, *c.* 2700–3000 m, February 1905, *Abbé Standaert* (BP – holotype; US! – isotype).

= *Parmelia etheridgensis* Elix in *Aust. J. Bot.* **29**: 355 (1981). Type: Australia, New South Wales, Etheridge Range, Kosciusko National Park, adjacent to Seamans Hut, 2060 m, on granite rocks, *J. A. Elix* 5771 (MEL! – holotype; CANB! – isotype).

Illustration: Elix (op. cit., as *Parmelia etheridgensis*).

Description. *Thallus* foliose, moderately to loosely adnate on rocks, yellow-green, irregularly lobate, *c.* 6 cm diam.; *lobes* irregular, imbricate or not, 2·0–5·0(–8·0) mm wide, margin crenate or in places lobulate, lobules simple, flat, 0·2–1·0 mm wide. *Upper surface* broadly undulating, shiny but soon appearing pruinose or subgranulate, emaculate, often black-margined, developing numerous dactyls or wart-like isidia, *dactyls* (isidia) coarse, short, globose, at first appearing pulvinate due to fine fissures in the cortex, later bursting open apically such that the thallus appears isidiose-pustulate, barely sorediate; medulla white. *Lower surface* pale brown to black-brown, darker still towards apices, moderately to sparsely rhizinate, rhizines simple, black. *Apothecia* 1–3 mm diam., rare, disc convex at first then ± plane, dark to black-brown; margin entire, persistent ± dactylate, exciple smooth or dactylate; spores 8–9 × 5–6 μm.



Map 24 Distribution of *Xanthoparmelia cordillerana* in Australia and New Zealand.

CHEMISTRY. Thallus K−; medulla K+ yellow becoming red, C−, P+ orange; containing usnic acid, salazinic acid, and consalazinic acid.

DISTRIBUTION. South-eastern Australia (NSW, ACT, Tas) and both islands of New Zealand. Map 24. On exposed rocks in alpine and subalpine zones. Specimens examined: 57.

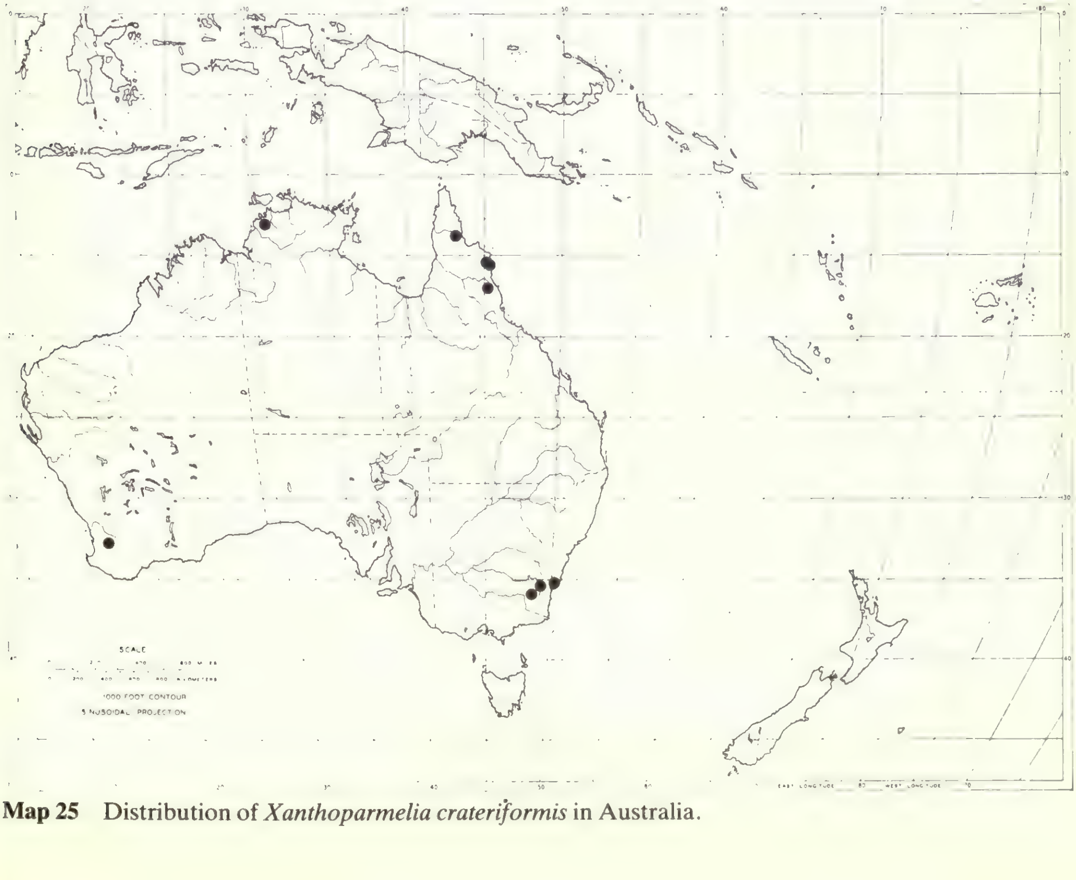
NOTES. This species resembles *X. pustuliza* in the development of open dactyls or subpustulate-isidia. These outgrowths are coarse and globose at first, but develop fissures in the upper cortex which gives the thallus an overall pulvinate appearance. Later these dactyls burst open apically and the hollow craters cause the thallus to appear pustulate. However *X. pustuliza* is adnate, and has a black lower surface, while *X. cordillerana* is loosely adnate with broader, irregular lobes which have a brown lower surface. Further, while *X. pustuliza* produces usnic, norstictic, and connorstictic acids, *X. cordillerana* produces usnic and salazinic acids.

X. cordillerana could also be confused with *X. scabrosa*, since this species also develops inflated isidia which often burst open at the apices, but here the thallus contains loxodin and norlobaridone, and the tendency for the isidia to become erumpent is much less marked. *X. praegnans* has erumpent isidia, a pale lower surface, and produces usnic and salazinic acids, but this species has a tightly adnate or subcrustose thallus with narrow, areolate, adnate lobes in contrast to the morphology of *X. cordillerana.*

X. cordillerana is essentially an alpine-subalpine species and common associates include various *Umbilicaria* spp., *Hypogymnia lugubris* (Pers.) Krog, and species of *Xanthoparmelia* including *X. tegeta* and *X. congesta*.

25. **Xanthoparmelia crateriformis** Elix & Jen Johnston, **sp. nov.**

Thallus ut in *Xanthoparmelia mougeotina* sed isidiis globosis, inflatis, apicibus saepe erumpentibus demum crateriformibus differt. Thallus arcte adpressus, versus centrum fere subcrustosum; superficies inferior



Map 25 Distribution of *Xanthoparmelia crateriformis* in Australia.

nigrescens. Thallus 70–110 μm crassus; cortex superior *c.* 14 μm crassus, stratum gonidiale 10–20 μm crassum, medulla 50–65 μm crassa, cortex inferior 15–25 μm crassus. Thallus K−; medulla K+ flavescens; C−, P+ aurantiaca.

Type: Australia, New South Wales, 8 km north-east of Nerriga, 750 m, 35°07′S, 150°08′E, on exposed sandstone rocks in open eucalypt forest, 6 October 1983, *J. A. Elix* 11582 (CBG! – holotype).
Illustration: Fig. 11.

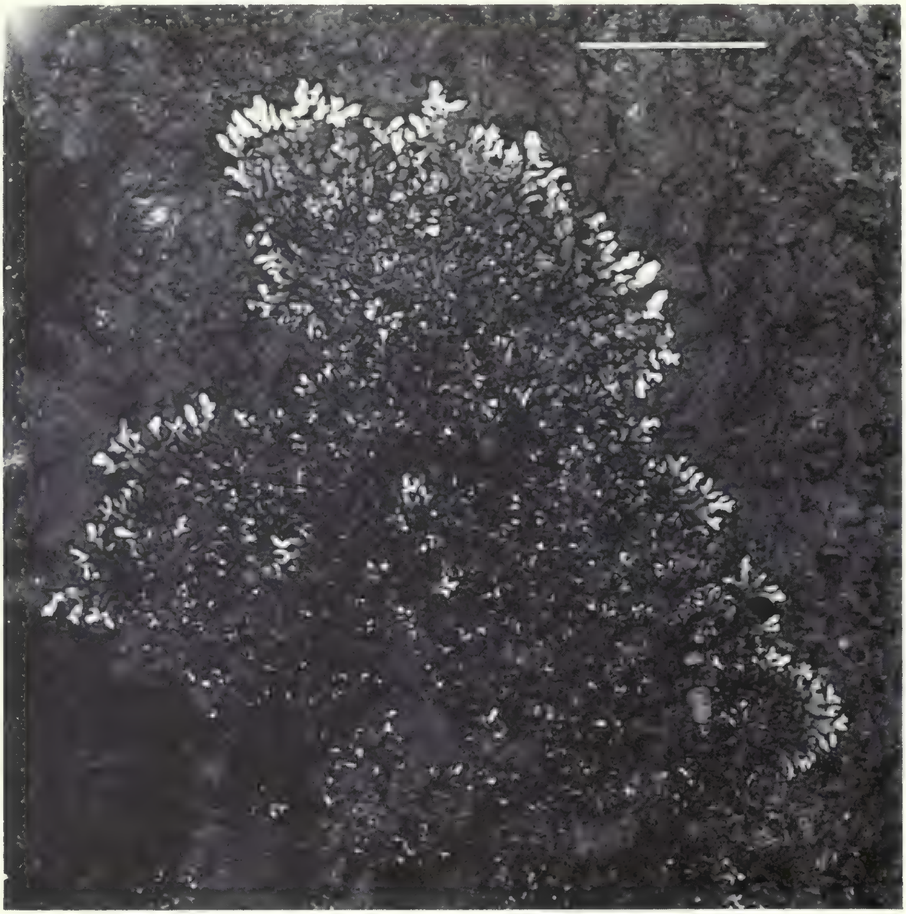


Fig. 11 *Xanthoparmelia crateriformis* Elix & Jen Johnston. Holotype in CBG. Scale = 0·5 cm.

DESCRIPTION. *Thallus* subcrustose, closely appressed, pale yellow-green darkening to yellow-brown or black centrally, 3–5 cm diam., ± rosette forming; *lobes* narrow, 0·5–0·8(–1·0) mm wide, stellate or rarely contiguous, not at all imbricate, apices markedly incised. *Upper surface* flat to slightly concave, shining at apices, dull and irregularly cracked near centre of thallus, becoming crustose-areolate with age, isidiate, *isidia* inflated – globose, simple, at first appearing pulvinate due to fine fissures in the cortex, later becoming erumpent at apices but barely sorediate, ultimately apically eroding leaving crater-like cavities; medulla white. *Lower surface* dark-brown to black, smooth, shining, sparsely rhizinate, rhizines simple, concolorous with lower surface. *Apothecia* not seen.

CHEMISTRY. Thallus K−; medulla K+ yellow, C−, KC−, P+ orange; containing usnic acid, stictic acid (major), constictic acid, norstictic acid (minor), and cryptostictic acid (trace), menegazziaic acid (± trace).

Distribution. Australia (Qld, NSW, ACT, WA, NT). Map 25. Scattered on rocks in warmer areas with more than 650 mm rainfall per annum. Specimens examined: 13.

Notes. This species closely resembles the common subcrustose *X. mougeotina*, in that both are characterised by tightly adnate, diminutive thalli with narrow lobes, a black or dark brown lower surface, the presence of isidia, and the production of the stictic acid complex in the medulla. *X. crateriformis* differs from *X. mougeotina* in the nature of the isidia: *X. mougeotina* having slender, subglobose to cylindrical isidia which may become slightly inflated but never erumpent, while in *X. crateriformis* the warty, inflated, coarse-globose isidia develop into dactyls, with the upper cortex developing fissures which give the isidia a pulvinate appearance. Later these isidia (dactyls) burst open apically and the hollow craters cause the thallus to appear pustulate.

X. crateriformis is a relatively uncommon species on rocks in the coastal ranges of eastern and northern Australia where associated species include *X. antleriformis, X. amplexula, X. exillima, X. streimannii,* and *X. tasmanica*.

This species was first recognized by Dr M. E. Hale and we thank him for bringing it to our attention.

26. **Xanthoparmelia cravenii** Elix & Jen Johnston, **sp. nov.**

Thallus ut in *Xanthoparmelia subcrustacea* sed acidum constipaticum (±), acidum protoconstipaticum (±) et scabrosinum 4,4′-dibutyratinum et scabrosinum 4-acetatinum-4′-butyratinum et scabrosinum 4-acetatinum-4′-hexanoatinum et ± scabrosinum 4,4′-diacetatinum continenti differt. Thallus arcte adnatus, areolatus. Superficies inferior pallido-brunnea. Thallus 120–160 μm crassus, cortex superior 20–28μm crassus, stratum gonidiale 28–36μm crassum, medulla 50–85 μm crassa, cortex inferior 7–11 ±m crassus. Thallus K−; medulla K−, C−, KC−, P−.

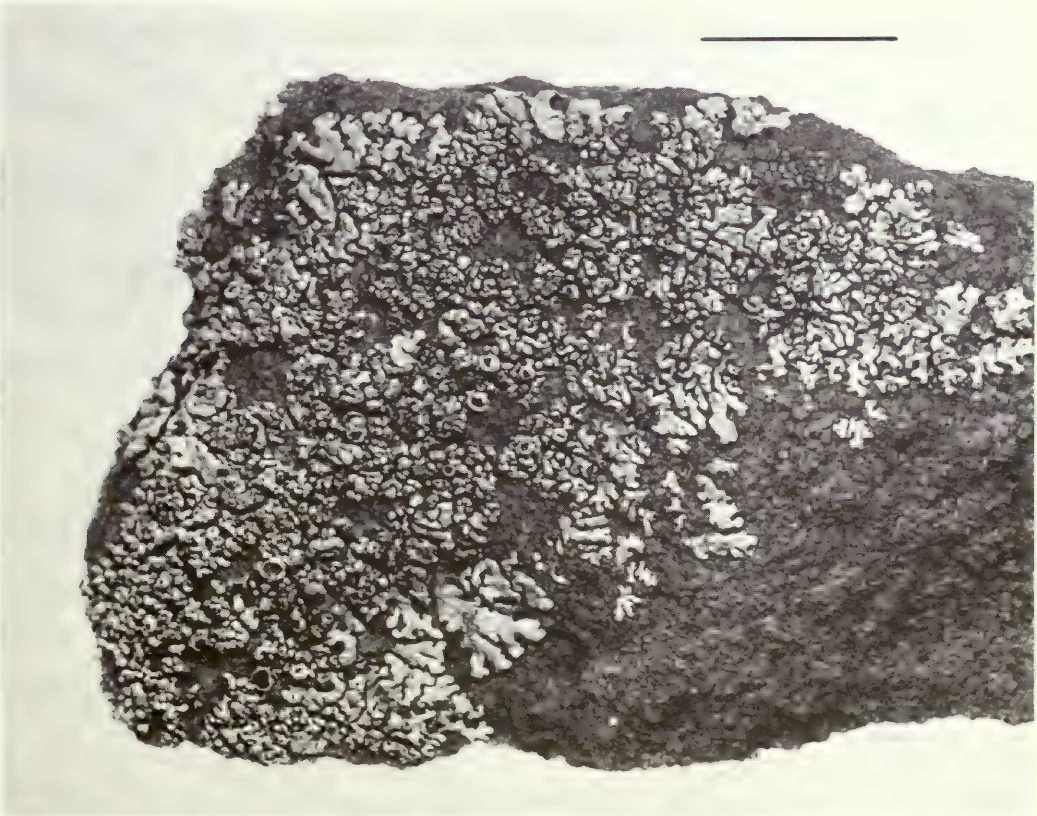


Fig. 12 *Xanthoparmelia cravenii* Elix & Jen Johnston. Portion of holotype in CBG. Scale = 1 cm.

Type: Australia, Northern Territory, Rodgers Pass, 48 km west of Stuart Highway along road to Kings Canyon, on quartzitic sandstone rocks with a southerly aspect, 11 September 1983, *J. A. Elix* 11118 & *L. A. Craven* (CBG! – holotype).

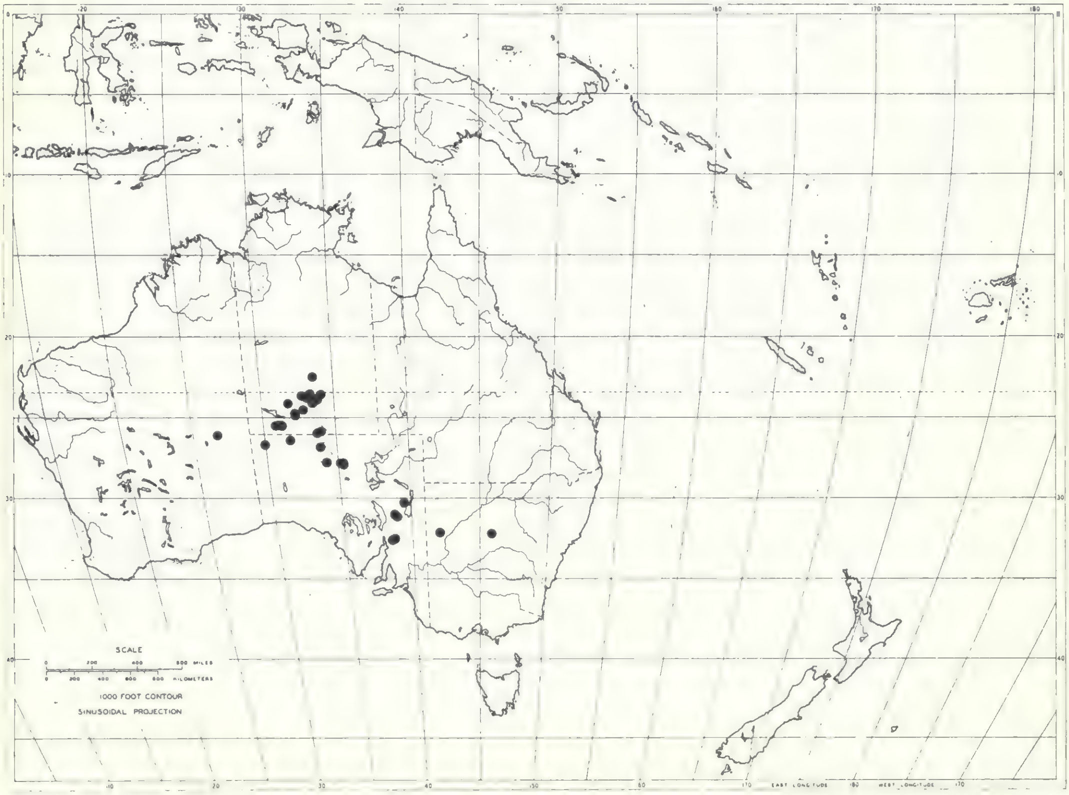
Illustration: Fig. 12.

DESCRIPTION. *Thallus* foliose to subcrustose, tightly adnate on rocks, yellow-green, darkening with age and becoming dark greyish green, 3–8 cm diam. *Lobes* sublinear-elongate to subirregular, imbricate or not, older lobes extensively fractured and areolae commonly formed, lobes 0·8–2·0(–2·5) mm wide and areolae *c.* 1·0 mm in diameter. *Upper surface* opaque or shiny towards periphery, emaculate, often tangentially cracked, becoming rugulose and areolate, commonly black-margined particularly towards lobe apices, lacking soredia and isidia; medulla white. *Lower surface* pale tan to light brown, often somewhat darker to smoke-grey near lobe apices, moderately to densely rhizinate, rhizines brown, simple. *Apothecia* substipitate, 1·0–2·0(–4·0) mm diam., margin thick, entire, disc concave, dark brown to black-brown, exciple smooth; spores 8·5–10·5 × 5–6 μm.

CHEMISTRY. Thallus K−; medulla K−, C−, KC−, P−; containing usnic acid, protoconstipatic acid (±), constipatic acid (±), scabrosin 4,4′-dibutyrate, scabrosin 4-acetate-4′-butyrate, scabrosin 4-acetate-4′-hexanoate, scabrosin 4,4′-diacetate (±), unknown scabrosin derivatives (±), unknown aliphatic acids (±).

DISTRIBUTION. Inland Australia: western NSW, northern SA, WA, and NT. Map 26. On rocks in arid areas. Specimens examined: 92.

NOTES. This species closely resembles *Xanthoparmelia subcrustacea* and *X. oleosa* in morphology, the thalli being tightly adnate, with narrow, sublinear-elongate lobes which often develop areolae in the older parts, and lower surface being pale brown. However, *X. subcrustacea* is



Map 26 Distribution of *Xanthoparmelia cravenii* in Australia.

chemically distinct since it produces usnic acid, hypostictic acid, hyposalazinic acid, and hypoconstictic acid (±), and consequently the medulla reacts K+ yellow-pale reddish. The distinctions between *X. cravenii* and *X. oleosa* are more subtle, but nonetheless consistent. Both taxa may produce the aliphatic acids, constipatic acid and protoconstipatic acid, but these are invariably accompanied by the four common scabrosin derivatives in *X. cravenii*. *X. oleosa*, on the other hand, lacks scabrosin derivatives in the medulla but often contains the additional aliphatic acids, dehydroconstipatic acid, and pertusaric acids. Morphologically *X. oleosa* differs in having a more diminutive thallus, narrower lobes (0·8–1·5 mm) with a brown to dark brown lower surface, while the larger thalli of *X. cravenii* have broader lobes (1–2 mm) with a pale tan lower surface. In general *X. oleosa* has a more southerly distribution than *X. cravenii*.

In central Australia *X. cravenii* is a common species on rock faces with a southerly aspect, where it occurs with other species of *Xanthoparmelia* including *X. australasica*, *X. praegnans*, *X. subdomokosii*, and *X. weberi*.

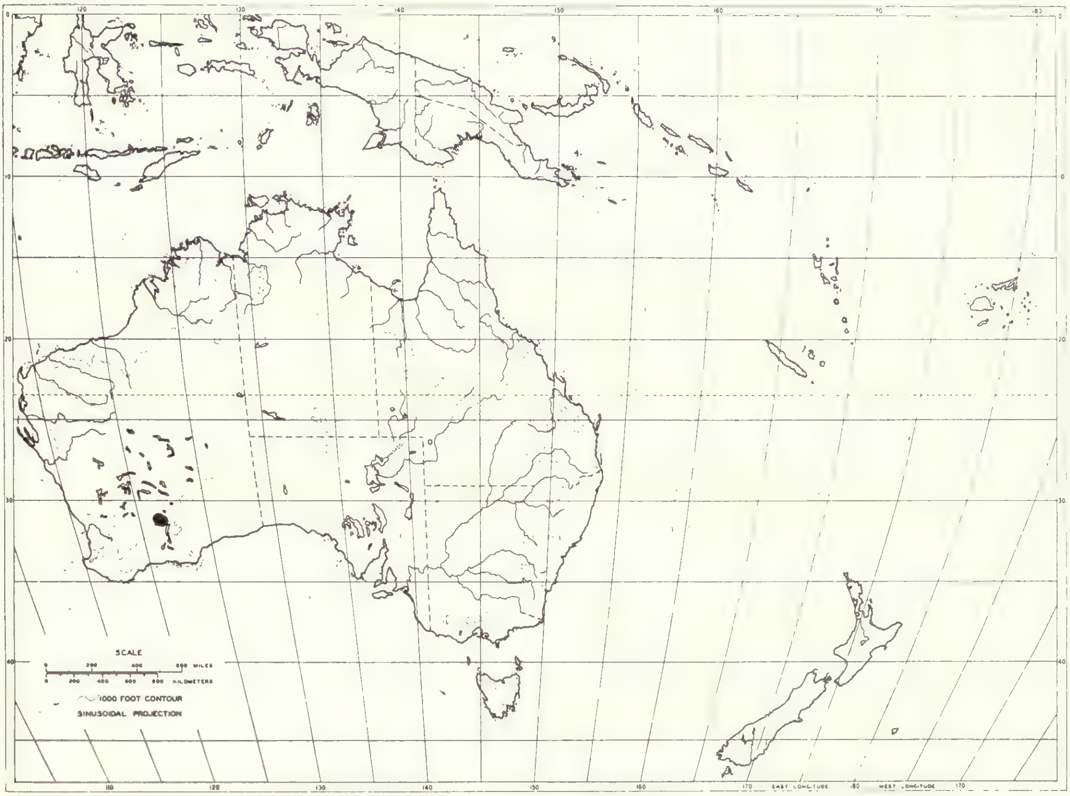
This species is named in honour of the Australian botanist, Mr L. A. Craven of the Australian National Herbarium.

27. **Xanthoparmelia dayiana** (Elix & P. Armstr.) Elix & Jen Johnston, **comb. nov.**

Basionym: *Parmelia dayiana* Elix & P. Armstr. in *Aust. J. Bot.* **31**: 468 (1983). Type: Australia, Western Australia, on rocks near Kalgoorlie, June 1982, *M. F. Day* (MEL! – holotype).

Illustration: Elix & Armstrong (op. cit.).

DESCRIPTION. *Thallus* subcrustose, tightly adnate, pale yellow-green; irregularly lobate, *c.* 2–3 cm diam.; lobes not at all imbricate, discrete at periphery of thallus, 0·5–1·0 mm wide, older lobes irregularly cracked and becoming areolate. *Upper surface* opaque, emaculate, often with



Map 27 Distribution of *Xanthoparmelia dayiana* in Australia.

numerous tangential cracks, with numerous isidia, *isidia* globose at first but becoming subcylindrical, branched or not, dactyliferous, (that is inflated at the apices and bursting open but not sorediose); medulla white. *Lower surface* pale brown to brown, moderately rhizinate, rhizines simple, concolorous with the lower surface. *Apothecia* not observed.

CHEMISTRY. Thallus K−; medulla K− or faint brown, C−, P+ orange red; containing usnic acid, fumarprotocetraric acid, succinprotocetraric acid, and traces of protocetraric acid.

DISTRIBUTION. Inland WA. Map 27. On exposed rock in arid shrubland. Specimens examined: 5.

NOTES. Morphologically this species closely resembles both *Xanthoparmelia praegnans* and *X. globulifera*; all three species have a pale brown lower surface, produce characteristic dactyliferous isidia, and have areolate, ± subcrustose thalli. Although *X. globulifera* and *X. praegnans* generally have broader lobes than *X. dayiana*, these three species can be distinguished most reliably by thin-layer chromatography of the secondary metabolites, since *X. globulifera* contains constipatic and protoconstipatic acids and *X. praegnans* salazinic acid.

The taxa are considered distinct species since they maintain their chemical integrity even when sympatric, and their secondary metabolites are biosynthetically distant compounds (Elix, 1982).

At present this species is only known from collections in the vicinity of Kalgoorlie where it associates with *Acarospora schleicheri* (Ach.) Massal., *Aspicilia* sp., *Caloplaca* sp., *Xanthoparmelia lineola, X. incerta,* and *X. praegnans*.

28. **Xanthoparmelia dichotoma** (Müll. Arg.) Hale

in *Phytologia* **28**: 487 (1974).

≡ *Parmelia dichotoma* Müll. Arg. in *Flora, Jena* **69**: 257 (1886). Type: Australia, New South Wales, Braidwood district, 1130 m, *Bauerlen* 204 (M! – holotype).

Illustration: Galloway in *N.Z. Jl Bot.* **18**: 535 (1980).

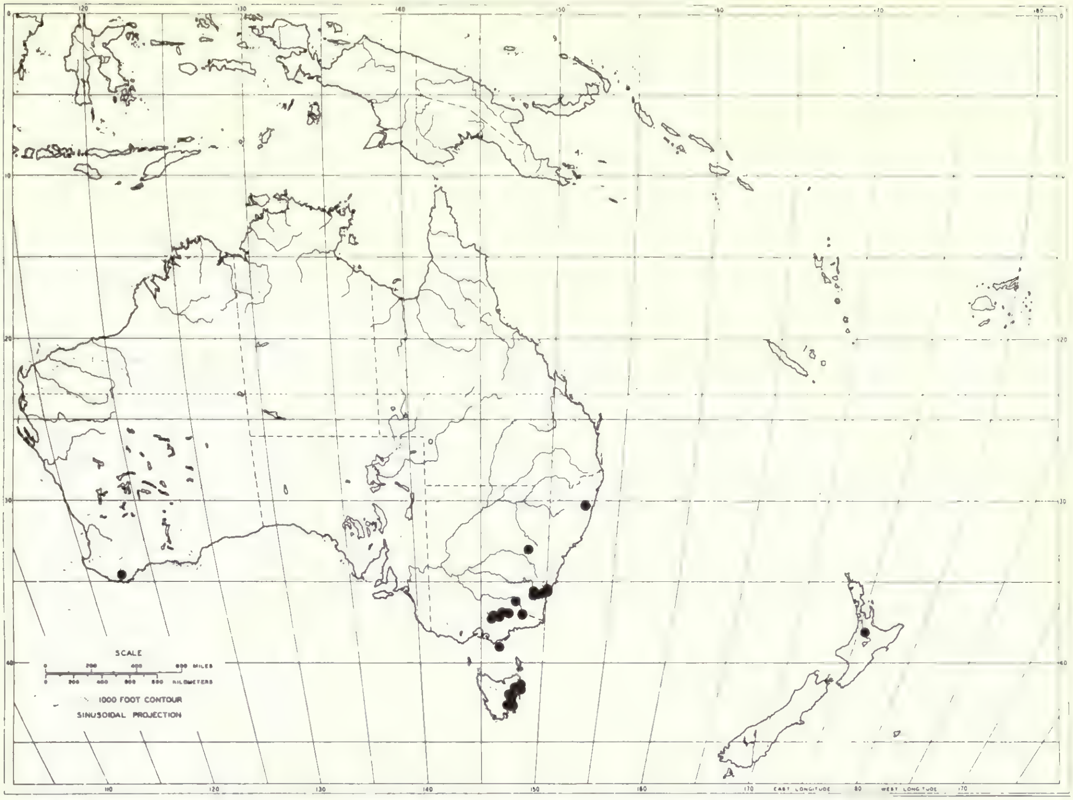
DESCRIPTION. *Thallus* foliose, saxicolous, loosely attached to substrate, pale yellow-green to grey-green, 7–10 cm diam. *Lobes* linear-elongate, 1–2·5 mm wide, to 15 mm long, divaricate, with irregular dichotomous branching, margins shining black or brown, often with subascending apices exposing lower surface. *Upper surface* smooth, shining, emaculate lacking soredia and isidia; medulla white. *Lower surface* black or dark brown, sometimes somewhat paler towards apices, shining or matt, wrinkled, very sparsely rhizinate, rhizines concolorous with the lower surface, simple, robust. *Apothecia* rare, to 6 mm diam., subpedicellate, disc brown shining, concave to plane, margin thick, entire or crenulate, exciple smooth, shining; spores 5–8 × 3·5–5 μm.

CHEMISTRY. Thallus K−; medulla K−, C−, KC+ rose, P−; containing usnic acid, loxodin, norlobaridone.

DISTRIBUTION. Eastern Australia (NSW, ACT, Vic, Tas) and North Island, New Zealand. Map 28. Loosely adnate on rocks in cooler areas with more than 750 mm rainfall per annum. Specimens examined: 63.

NOTES. This species is characterised by the narrow, markedly linear-elongate lobes with dichotomous branching, and the black to brown-black, rugulose lower surface with sparse but robust rhizines. Morphologically *X. dichotoma* closely resembles *X. furcata* and *X. rupestris*, and the distinction of these two species is discussed under the latter. This species also resembles the *X. subnuda* group, namely *X. multipartita, X. eradicata, X. suberadicata*, and *X. subnuda*. These lichens all have linear-elongate, dichotomously divided lobes which are ± subascending at the apices and a black, sparsely rhizinate lower surface. Lobes of *X. dichotoma* are generally more linearly-elongate and more sparsely branched than those of the other species. Furthermore, *X. dichotoma* is chemically dissimilar, since it contains the orcinol depsidones loxodin and norlobaridone (K−) while the *X. subnuda* group all contain β-orcinol depsidones (K+).

X. dichotoma favours moist rocks and commonly occurs on exposed rock surfaces where



Map 28 Distribution of *Xanthoparmelia dichotoma* in Australia and New Zealand.

run-off water drains or collects. In contrast the related *X. furcata* is found on dry, well-drained rock surfaces. *X. dichotoma* is a relatively common species in the upland areas of south-eastern Australia where common associates include *Hypogymnia tubularis* (Taylor) Elix, *Parmelia signifera* Nyl., and other species of *Xanthoparmelia* including *X. scabrosa, X. flavescentireagens, X. eradicata*, and *X. substrigosa*.

29. **Xanthoparmelia digitiformis** (Elix & P. Armstr.) Filson

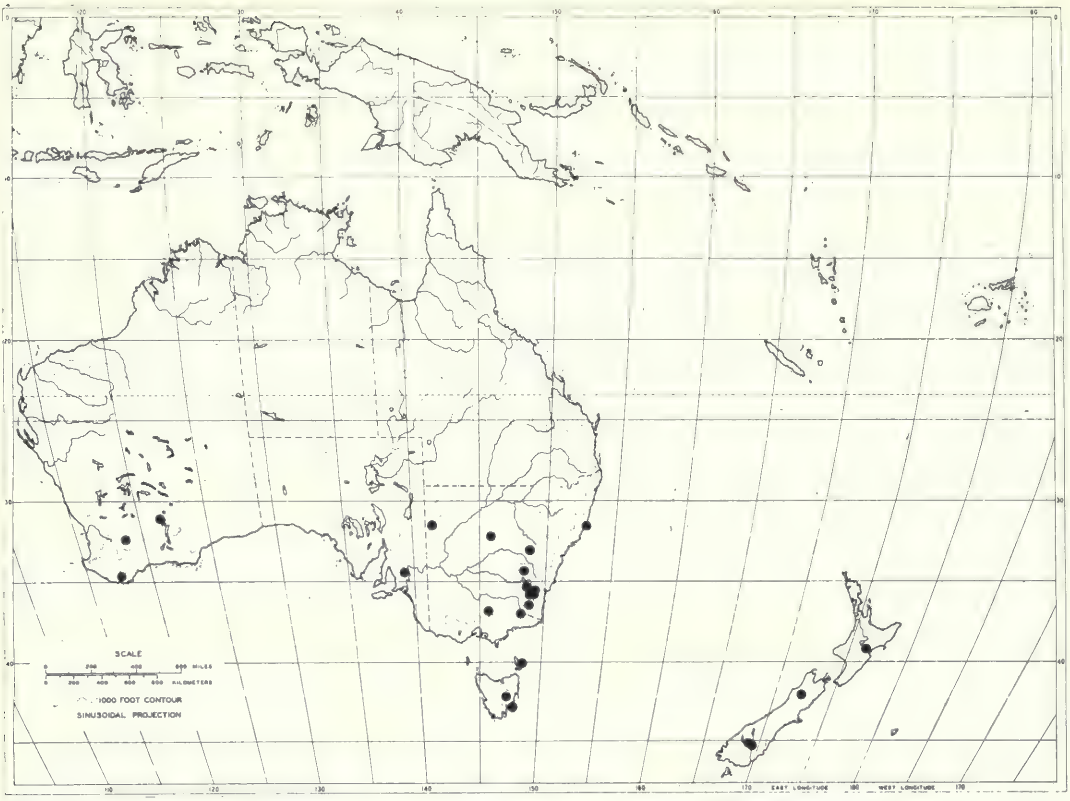
in *Brunonia* **7**: 205 (1984).

≡ *Parmelia digitiformis* Elix & P. Armstr. in *Aust. J. Bot.* **31**: 470 (1983). Type: Australia, Australian Capital Territory, Booroomba Rocks, 11 km south-west of Tharwa, on sheltered granite rocks in subalpine heath, 11 July 1979, *J. A. Elix* 6173 (MEL! – holotype).

Illustration: Elix & Armstrong (op. cit.).

DESCRIPTION. *Thallus* foliose, adnate to loosely adnate on rocks, pale yellow-green, blackening with age, to 20 cm diam.; *lobes* subirregular, strongly imbricate, with ± rotund apices, 1·5–3 mm wide, secondary lobes similar to marginal lobes but narrower (1–2 mm wide), elongate, digitately to subdigitately divided, building up thallus into a thick mat. *Upper surface* shiny, emaculate, older lobes becoming rugulose, dull and cracked, margins often blackened, lacking soredia and isidia; *lower surface* brown to dark brown, darker towards apices, sparsely rhizinate, rhizines simple, slender, concolorous with lower surface. *Apothecia* to 6 mm wide; margin thin, crenulate to flexuose, involute at first but almost disappearing at maturity, disc dark brown, dull, concave, smooth becoming rugulose; spores 7–10 × 4–6 μm.

CHEMISTRY. Thallus K−; medulla K− yellow becoming red, C−, KC−, P+ yellow becoming



Map 29 Distribution of *Xanthoparmelia digitiformis* in Australia and New Zealand.

orange; containing usnic acid, salazinic acid, consalazinic acid, ± traces of norstictic acid and protocetraric acid.

DISTRIBUTION. Southern Australia (NSW, ACT, Vic, Tas, SA, WA) and both islands of New Zealand. Map 29. On rocks in upland areas and drier subalpine zones. Specimens examined: 34.

NOTES. This species appears to be related to *X. taractica* since both have a pale lower surface and contain usnic and salazinic acids. However, the lobes of *X. taractica* are generally broader (2–4(–8) mm wide) and the lower surface densely rhizinate, especially near the margins; this species is usually terricolous or growing over pebbles and spreading on to soil. On the other hand, in *X. digitiformis* the lower surface is sparsely rhizinate and becomes rugulose and ridged near the apices and ± devoid of rhizines in that region, the lobes are narrower (1·5–2·5(–3) mm wide) and more elongated, and the thallus is always saxicolous.

Morphologically this species resembles some forms of *X. elixii*, but the latter species contains norstictic, connorstictic, and salazinic acid, rather than the preponderant salazinic acid of *X. digitiformis*. Apart from these chemical differences, the lobes of *X. elixii* are often broader and subascending at the apices, while in *X. digitiformis* the lobes are more or less flat throughout.

X. digitiformis is a common species with a scattered distribution, often associating with other species of *Xanthoparmelia* including *X. flavescentireagens, X. elixii, X. notata*, and *X. tasmanica*.

30. **Xanthoparmelia dissitifolia** Kurok. ex Elix & Jen Johnston, **sp. nov.**

Thallus ut in *Xanthoparmelia mougeotina* sed superne exisidiatus et acidum norsticticum et acidum connorsticticum continenti etiam differt. Thallus adpressus, parvofoliaceus, superficie inferiore nigrescenti. Thallus 50–100 μm crassus; cortex superior 13–26 μm crassus, stratum gonidiale 5–11 μm crassum,

medulla 50–65 µm crassa, cortex inferior 2–8 µm crassus. Thallus K−; medulla K+ lutea deinde aurantiaco-rubescens, C−, P+ lutea.

Type: Australia, Western Australia, 29 km south of Collie, *c*. 230 m, on rocks, *S. Kurokawa* 6642 (MEL 34363! – isotype, TNS – holotype).
Illustration: Fig. 13.

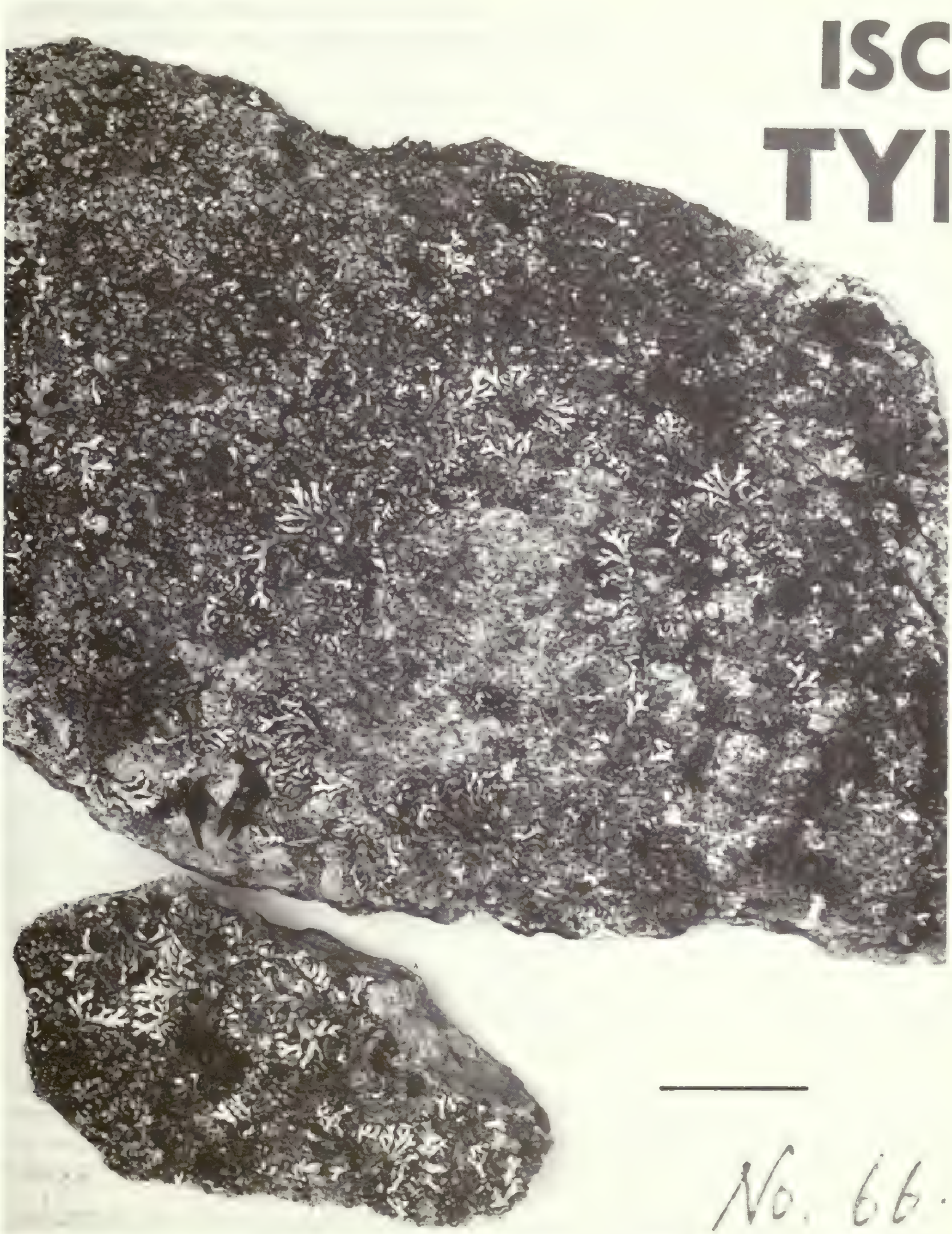
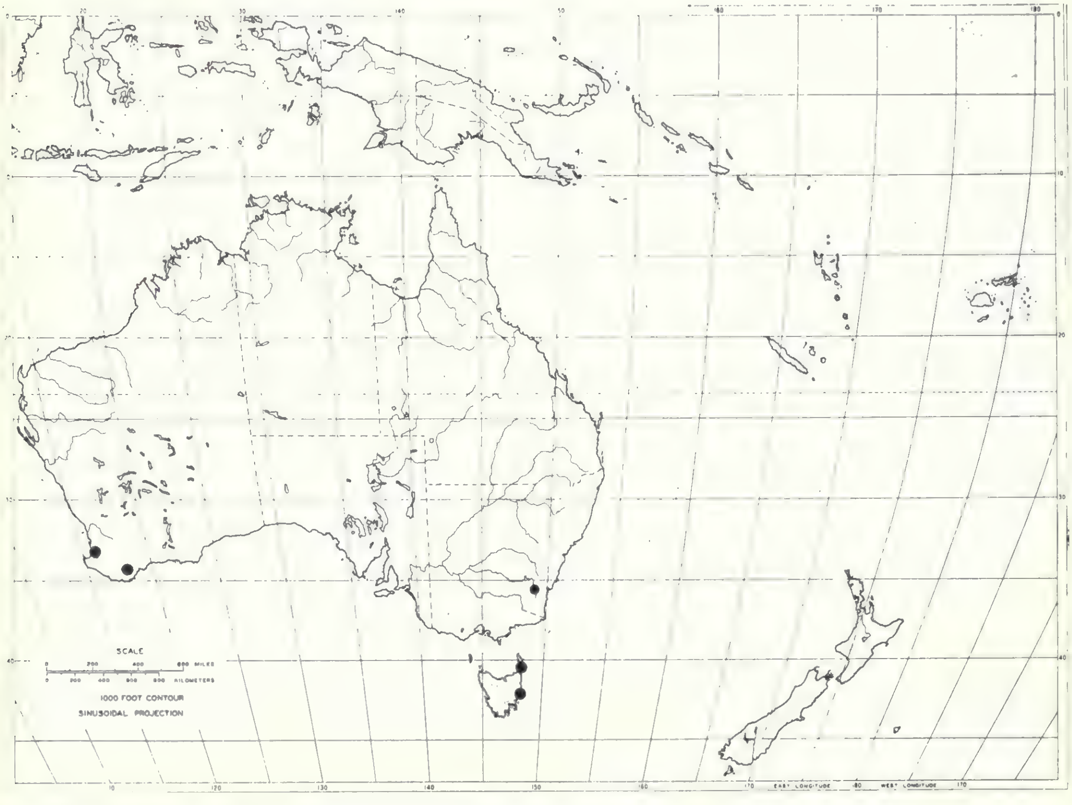


Fig. 13 *Xanthoparmelia dissitifolia* Kurok. ex Elix & Jen Johnston. Portion of isotype in MEL. Scale = 1 cm.

DESCRIPTION. *Thallus* small-foliose, adnate to tightly adnate on rocks, yellow-green, darkening with age, 2–4 cm diam.; *lobes* radiating at periphery, linear-elongate, dichotomously or subdichotomously divided, rarely imbricate, 0·3–0·7(–1·0) mm wide, older lobes tangentially fractured and areolae commonly formed, central lobes eventually eroding. *Upper surface* shiny, emaculate, eventually developing tangential cracks, margins distinctly blackened, lacking soredia and isidia; medulla white. *Lower surface* black, moderately rhizinate, rhizines simple, black. *Apothecia* substipitate, 1–2 mm diam., slightly concave at first but becoming plane or convex, margin thin, entire then undulate or denticulate, disc dark brown to blackish; spores 8 × 5–6 μm.

CHEMISTRY. Thallus K−; medulla K+ yellow becoming red, C−, KC−, P+ yellow; containing usnic acid, norstictic acid, minor quantities of connorstictic acid (±) and traces of salazinic acid (±).

DISTRIBUTION. ACT, Bass Strait Islands, Tas, and southwestern WA. Also in South Africa. Map 30. On exposed rocks in coastal areas and the adjacent hinterland. Specimens examined: 5.



Map 30 Distribution of *Xanthoparmelia dissitifolia* in Australia.

NOTES. This distinctive species is characterised by the minute, linear-elongate, tightly adnate ± radiating lobes, with a black lower surface; it resembles some forms of *X. mougeotina*. However *X. mougeotina* is isidiate and contains stictic acid, constictic acid, and associated compounds in the medulla, while *X. dissitifolia* is non-isidiate and contains norstictic acid and connorstictic acid.

This species also resembles *X. parvoincerta* in the configuration of the lobes and the black lower surface, but *X. parvoincerta* produces salazinic acid in the medulla. Further, the lobes of *X. parvoincerta* are somewhat broader (0·5–1·0 mm) than those of *X. dissitifolia* (0·3–0·7 mm), are not as linear-elongate, and are more often imbricate. Lobes of *X. dissitifolia* are rarely imbricate.

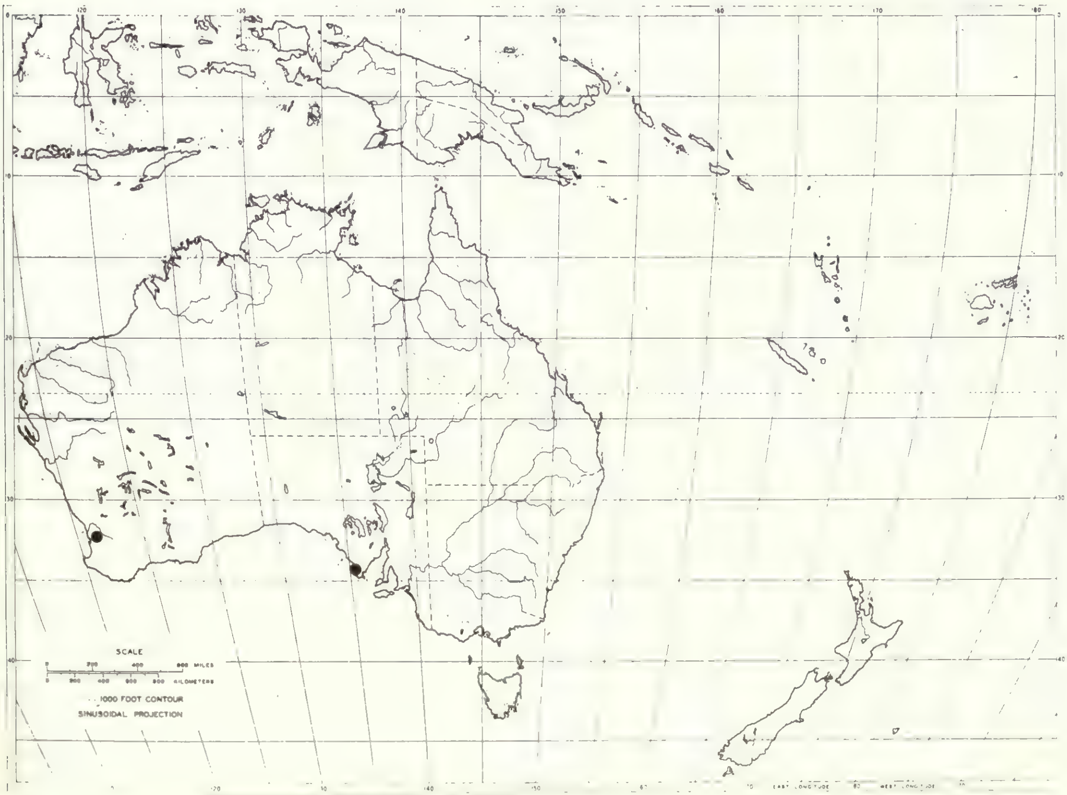
X. dissitifolia is rare, associating with common species of *Xanthoparmelia* including *X. isidiigera, X. tegeta, X. neorimalis,* and *X. adhaerens*.

31. Xanthoparmelia donneri Elix & Jen Johnston, sp. nov.

Thallus ut in *Xanthoparmelia mougeotina* sed superne exisidiata et acidum barbaticum et acidum norsticticum continenti differt. Thallus arcte adpressus, versus centrum fere subcrustosum; superfice inferiore nigrescens. Thallus 90–180 μm crassus; cortex superior 20–35 μm crassus, stratum gonidiale 14–20 μm crassum, medulla 60–105 μm crassa, cortex inferior 14–17 μm crassus. Thallus K−; medulla K+ lutea deinde aurantiaco-rubescens, C−, P+ lutea.

Type: Australia, South Australia, Eyre Peninsula, south-west corner, hundred of Warrow, section B, south-eastern end of Marble Range, *c.* 45 km north-west of Port Lincoln, on rocks, 25 August 1967, *N. N. Donner* 2086 (AD 97550249! – holotype).
Illustration: Fig. 14.

Description. *Thallus* small-foliose to subcrustose, very tightly adnate to rocks, yellow-green to yellow, darkening to deep olive-brown or blackish in older lobes, 2–4 cm diam.; *lobes* contiguous or stellate, narrow, 0·2–0·8(–1·0) mm wide, not at all imbricate, becoming cracked and often forming areolae 0·2–0·5 mm diam. in centre of thallus. *Upper surface* opaque, emaculate, lacking soredia and isidia but developing tangential cracks in older lobes; medulla white. *Lower surface* dark-brown to black, densely rhizinate, rhizines simple, black or else lower surface adhaering directly to substrate. *Apothecia* common, substipitate to sessile, 0·3–1·0 mm diam., disc black, exciple smooth, margin narrow, entire, ± crenulate; spores 7–11 × 5–6 μm.



Map 31 Distribution of *Xanthoparmelia donneri* in Australia.

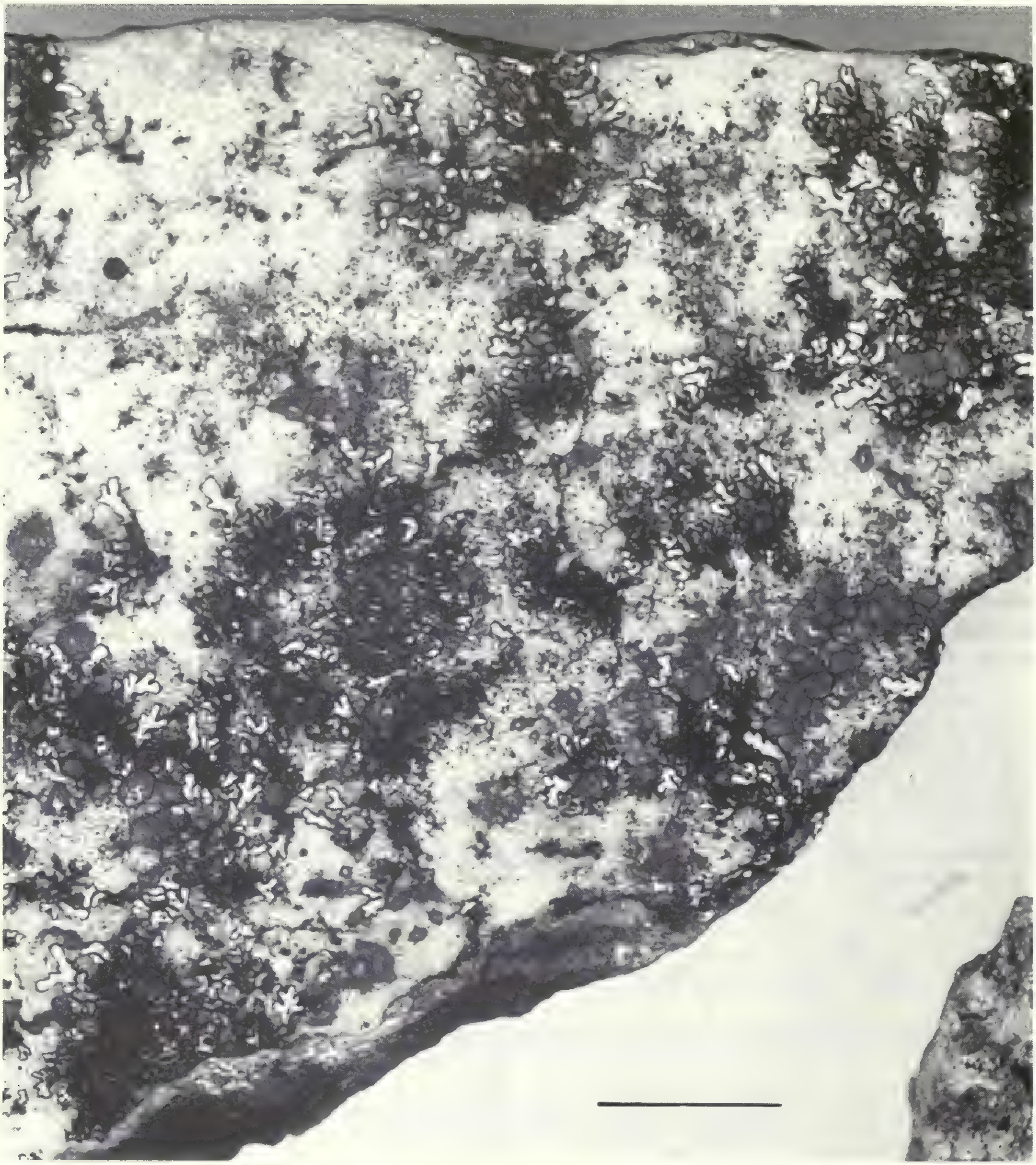


Fig. 14 *Xanthoparmelia donneri* Elix & Jen Johnston. Portion of holotype in AD. Scale = 0·5 cm.

CHEMISTRY. Cortex K−; medulla K+ yellow becoming red-orange, C−, P+ yellow; containing usnic acid, barbatic acid, norstictic acid, connorstictic acid (minor) and traces of hyposalazinic acid (±) and unknown substances (±).

DISTRIBUTION. Eyre Peninsula (SA) and south-western WA. Map 31. On exposed acidic rocks in hinterland ranges. Specimens examined: 2.

NOTES. This species is characterised by the subcrustose thallus, the tightly adnate lobes with a black lower surface, and the production of barbatic acid, norstictic acid, and connorstictic acid in the medulla.

Morphologically *X. donneri* closely resembles *Xanthoparmelia adhaerens* and *X. louisii*, but *X. adhaerens* contains stictic acid and constictic acid in the medulla, and *X. louisii* contains barbatic acid and 4-*0*-demethylbarbatic acid, so that these three are readily distinguished chemically. These taxa could be considered chemical strains, but since they appear to show different geographical distributions we have decided to maintain them as distinct species. *X. adhaerens* occurs in South Africa and is distributed much more widely in southern Australia (WA, SA, Vic, NSW, and ACT) than is *X. donneri*, which appears to be restricted to south-west Western Australia and Eyre Peninsula, while *X. louisii* is only found in south-west Western Australia.

Chemically *X. donneri* is unique in Australasia, but *X. schmidtii* Hale from North America contains a similar combination of medullary acids. The latter species is quite distinct morphologically since it is isidiate and has broad, conspersoid lobes.

This species has been named in honour of the South Australian botanist and lichenologist, Mr N. N. Donner.

32. **Xanthoparmelia dubitata** Elix & Jen Johnston, **sp. nov.**

Thallus ut in *Xanthoparmelia adhaerens* sed superficie inferiore straminea et norlobaridonum continenti differt. Thallus arcte adpressus, versus centrum fere subcrustosus. Superficies inferior pallido-brunnea. Thallus 175–210 μm crassus; cortex superior 20–35 μm crassa, cortex inferior 10–14 μm crassus. Thallus K−; medulla K−, C−, KC+ roseus, P−.

Type: Australia, Victoria, 1 km north of Tallarook, on rocks in dry sclerophyll forest, 29 July 1978, *J. A. Elix* 4871 (CBG! – holotype).

Illustration: Fig. 15.

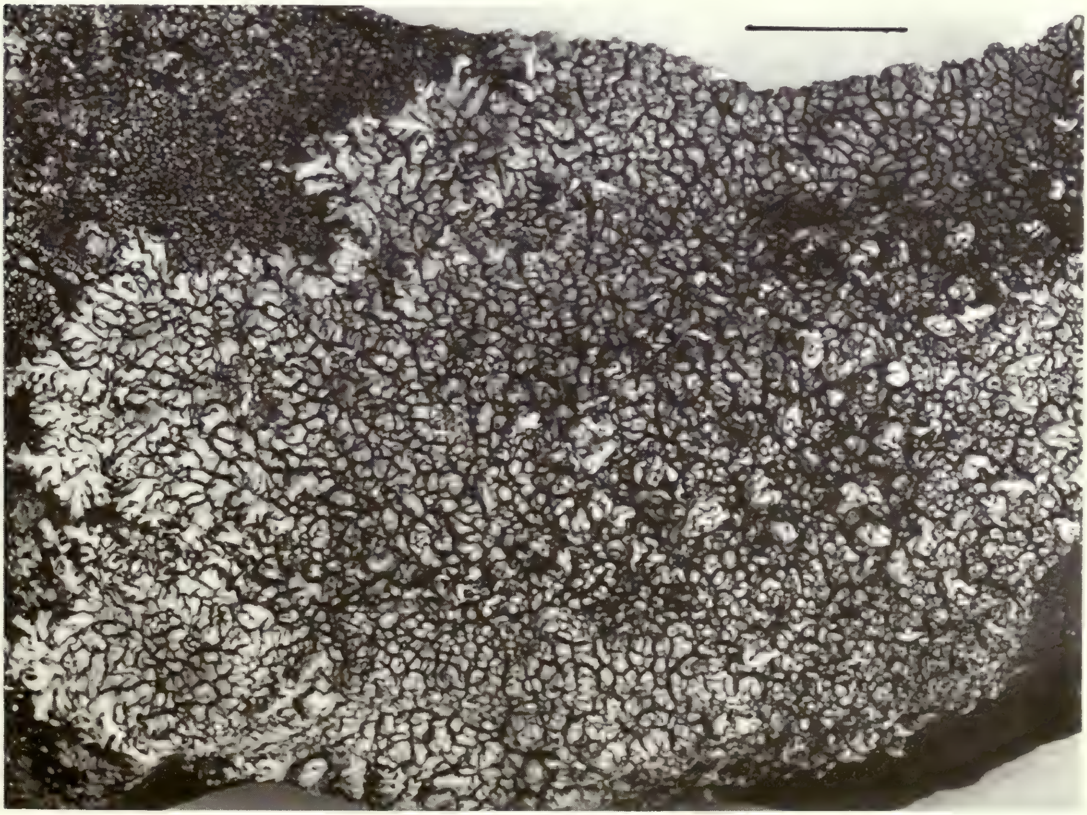


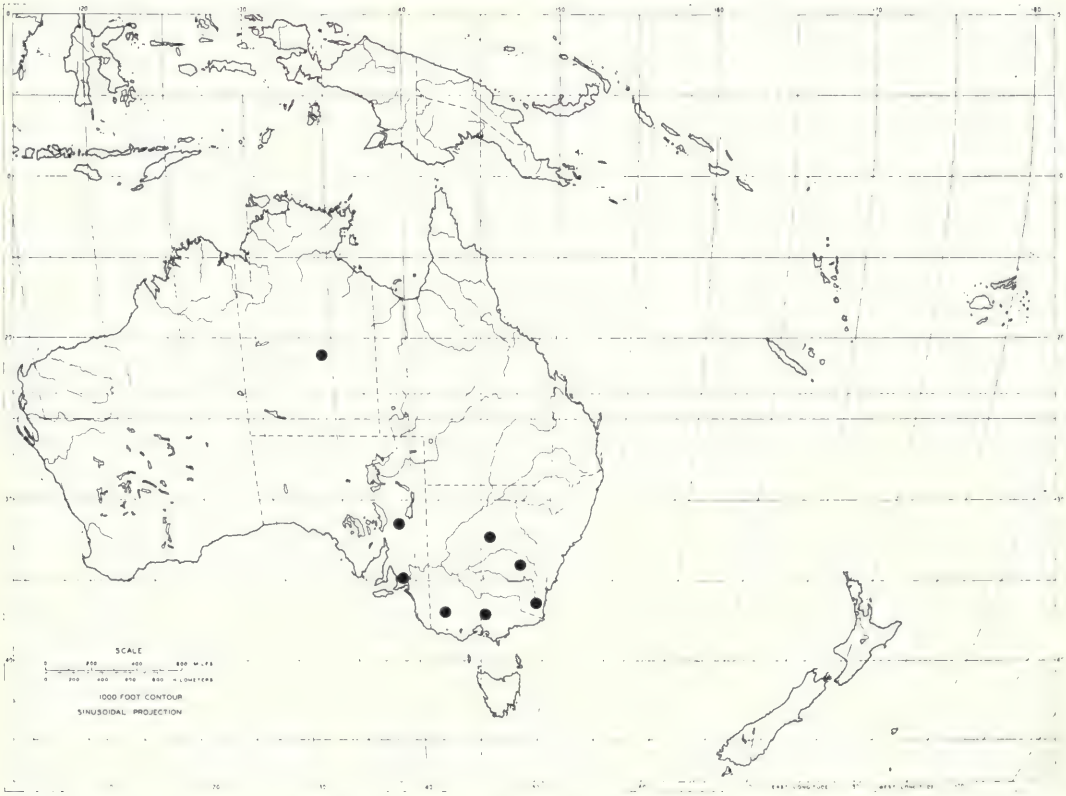
Fig. 15 *Xanthoparmelia dubitata* Elix & Jen Johnston. Portion of holotype in CBG. Scale = 0·5 cm.

DESCRIPTION. *Thallus* subcrustose, very tightly adnate to rocks, yellow-green, darkening to deep olive-brown or blackish on older lobes near centre, 2–4 cm diam.; *lobes* highly congested, subirregular, rarely imbricate, 0·2–0·5(–1·0) mm wide, plane or convex above, forming convex areolae in centre of thallus, ± developing convex, branched secondary lobes in central areolate region. *Upper* surface opaque, emaculate, irregularly cracked and older lobes becoming distinctly rugulose and areolate; lacking soredia and isidia; medulla white. *Lower surface* straw yellow but often darkening towards lobe apices, sparsely rhizinate, rhizines simple, brown to pale brown. *Apothecia* sessile, 1–4 mm diam., disc dark brown to brown, deeply concave and then ± plane, margin thick, entire, ± undulating, exciple smooth; spores 7–9 × 3·5–5·5 μm.

CHEMISTRY. Thallus K−; medulla K−, C−, KC+ rose, P−; containing usnic acid, norlobaridone.

DISTRIBUTION. South-eastern and central Australia (NSW, Vic, SA, NT). Map 32. On rocks in hilly areas from arid to subalpine zones. Specimens examined: 9.

NOTES. This subcrustose species closely resembles *Xanthoparmelia adhaerens* in overall growth form, with highly congested narrow lobes, but differs from it in having a pale lower cortex and in containing norlobaridone rather than stictic acid. *X. dubitata* appears to be related to *X. exillima* because these two species have similar saxicolous habitats, subcrustose thalli with a pale lower surface, and both produce usnic acid and norlobaridone. However, *X. exillima* is clearly distinguished by the presence of isidia. Occasionally *X. dubitata* tends to intergrade with *X. filarszkyana*, a tightly adnate species with broad lobes and rotund apices. Although chemically similar, *X. filarszkyana* usually produces both loxodin and norlobaridone in the medulla, while *X. dubitata* only produces norlobaridone. The central areolate lobes of *X. incrustata* also



Map 32 Distribution of *Xanthoparmelia dubitata* in Australia.

resemble those of *X. dubitata*, but *X. incrustata* has a much more robust thallus, with broader more loosely adnate lobes and characteristic, canaliculate marginal lobes.

An apparently rare but possibly overlooked species, *X. dubitata* is usually found on rocks in upland areas where it often associates with *Physcia caesia* (Hoffm.) Fürnrohr., *Neofuscelia pulla* (Ach.) Essl. and other species of *Xanthoparmelia* including *X. exillima, X. xanthosorediata, X. substrigosa,* and *X. flavescentireagens*.

Key to the *Xanthoparmelia dubitata* group in Australasia

Thallus tightly adnate, subcrustose in part, lobes narrow (0·5–1·5 mm wide), lacking isidia; lower surface pale.

1a.	Marginal lobes sublinear-elongate	2
1b.	Marginal lobes short, irregular	5
2a(1a).	Medulla K+ yellow-red or brownish	3
2b.	Medulla K−	4
3a(2a).	Medulla K+ yellow-deep red (salazinic acid)	**74. X. neorimalis** (p. 296)
3b.	Medulla K+ yellow-brown (fumarprotocetraric, succinprotocetraric acids)	**81. X. pertinax** (p. 306)
4a(2b).	Lobes 0·8–1·5 mm wide (constipatic, dehydroconstipatic, traces fatty acids)	**79. X. oleosa** (p. 303)
4b.	Lobes 0·5–1·0 mm wide (scabrosin derivatives)	**26. X. cravenii** (p. 223)
5a(1b).	Medulla K+ yellow-pale red (hypostictic, hyposalazinic acids)	**95. X. subcrustacea** (p. 325)
5b.	Medulla K−	6
6a(5b).	Medulla KC+ rose (norlobaridone)	**32. X. dubitata** (p. 233)
6b.	Medulla KC− (hypoprotocetraric acid)	**60. X. laxencrustans** (p. 275)

33. Xanthoparmelia eilifii Elix & Jen Johnston, nom. nov.

≡ *Parmelia dahlii* Kurok. in *Bull. natn. Sci. Mus. Tokyo* B, **8**: 36 (1982), non *Parmelia dahlii* (Hale) A. Singh, *Lichenology Indian Subcontinent 1966–1977*: 2 (1980) (Art. 64.1). Type: Australia, New South Wales, along the Sturt Highway about 11 km east of Mildura, *E. Dahl* (O – holotype; TNS – isotype; CANB! – isotype).

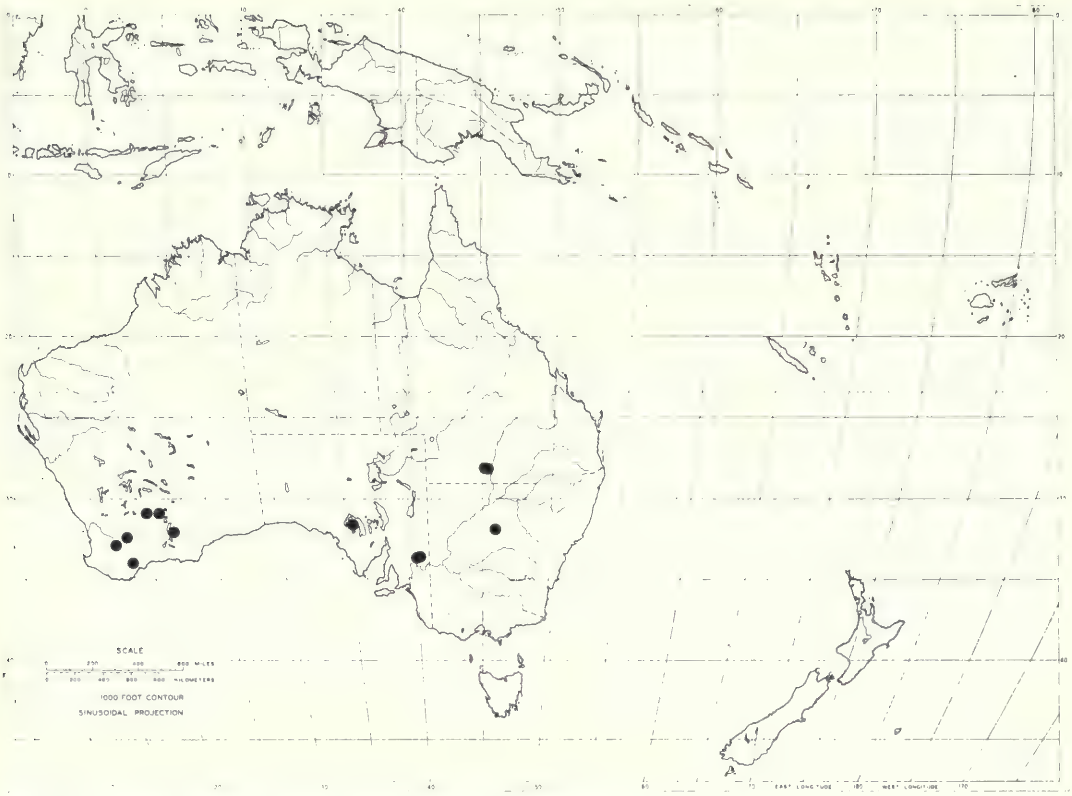
Illustration: Kurokawa (op. cit., as *Parmelia dahlii*).

DESCRIPTION. *Thallus* foliose, loosely attached to soil and debris, pale yellow-green, forming loosely disjointed patches to 10 cm diam.; *lobes* elongate, subdichotomously divided, revolute, distorted, 1·0–2·0(–3·0) mm wide, often entangled, secondary lobes narrower, 0·3–0·5 mm wide, often growing over primary lobes or occasionally developing as revolute lobulae in centre of thallus and along margins of older lobes. *Upper surface* dull, slightly rugulose, convex, lacking soredia, isidia and maculae; medulla white. *Lower surface* pale brown to brown, sparsely to moderately rhizinate, rhizines simple, concolorous with lower surface; lobules with dark-brown to black-brown lower surface and rhizines. *Apothecia* not seen.

CHEMISTRY. Cortex K−; medulla K−, C−, KC+ pale reddish, P−; containing usnic acid, loxodin, and norlobaridone.

DISTRIBUTION. Inland Australia (Qld, NSW, SA, WA). Map 33. On soil in mallee scrub and in subarid shrubland. Specimens examined: 16.

NOTES. This species belongs to a group of soil-inhabiting species of *Xanthoparmelia* characterised by markedly convex lobes and revolute secondary lobes growing from lobules on margins of older lobes in the centre of the thallus. This group includes *X. alternata, X. versicolor, X. molliuscula, X. terrestris, X. pumila*, and *X. norpumila*. However, the undersurface of the lobes is usually pale brown to dark brown in *X. eilifii*, whereas it is pale yellow or pale tan with a yellow rim in *X. alternata, X. molliuscula*, and *X. terrestris*, and black in the remaining three. *X. eilifii* is also distinguished chemically as all the other species are P+ yellow or orange. A key to this group of species is given under *X. versicolor*.



Map 33 Distribution of *Xanthoparmelia eilifii* in Australia.

X. eilifii also appears to be closely related to *X. subdistorta* since both species have sublinear and mainly dichotomously branched lobes, with a pale brown to dark brown lower surface, and produce loxodin and norlobaridone. The lobes of *X. eilifii* tend to be broad (1–2 mm wide) and rather flat though ± canaliculate below but never become terete, while they are narrow (0·5–0·8 mm wide), strongly revolute and become terete, especially near the apices, in *X. subdistorta*.

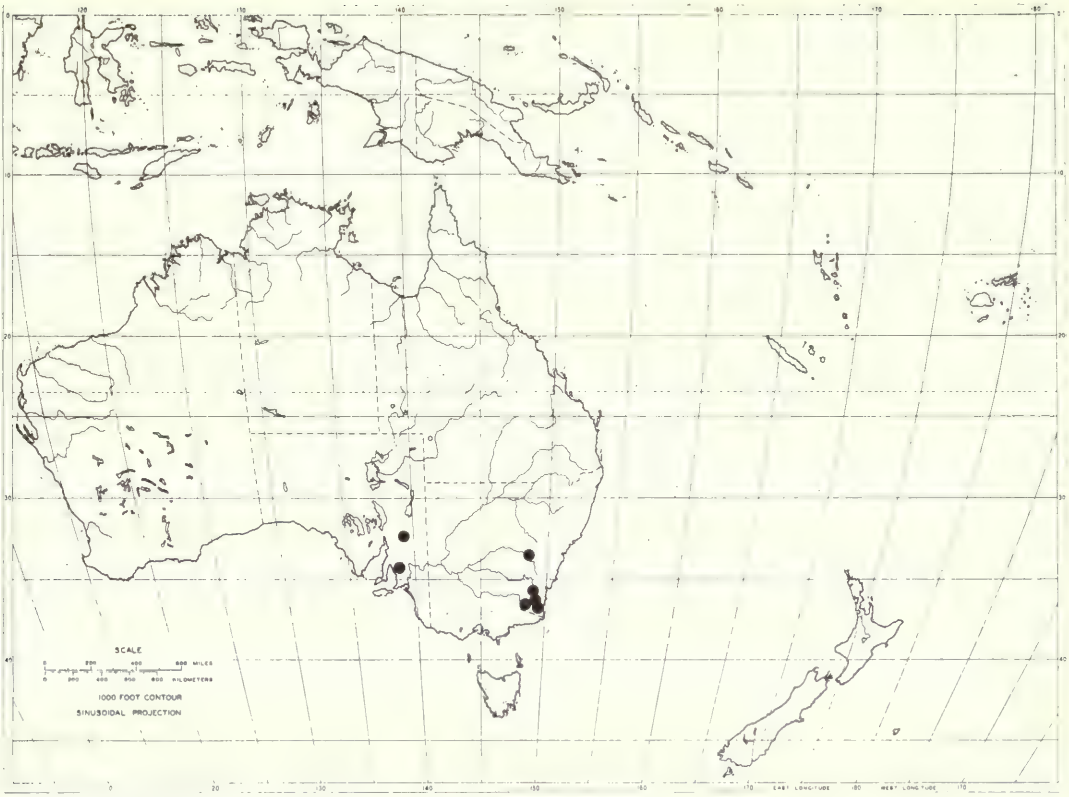
X. eilifii is a rare, but widely dispersed species occurring on soil in arid areas together with *X. versicolor, X. terrestris, X. bellatula, X. amphixantha, X. reptans*, and *Chondropsis semiviridis* (Nyl.) Nyl.

34. **Xanthoparmelia elaeodes** (Elix) Elix & Jen Johnston, **comb. nov.**

Basionym: *Parmelia elaeodes* Elix in *Aust. J. Bot.* **29**: 354 (1981). Type: Australia, New South Wales, 13 km south of Countegany along the Nimmitabel road, 1035 m, on granite rocks, *J. A. Elix* 1980 (MEL! – holotype).

Illustration: Elix (op. cit.).

Description. *Thallus* foliose, adnate to tightly adnate on rocks, yellow-green, or becoming olive-green near centre and blackening with age, 4–7 cm diam., subirregularly lobate; *lobes* sublinear-elongate, imbricate or not, 1·0–2·0 mm wide. *Upper surface* shiny but becoming dull and developing tangential or irregular cracks with age, emaculate, commonly with black margins, lacking soredia and isidia; medulla white. *Lower surface* black, densely rhizinate to margins, rhizines short, simple, black. *Apothecia* adnate, 1·0–3·5 mm diam., disc dark brown, margin entire at first but later becoming undulate and irregularly cracked; spores 6–8 × 4·5–5·5 μm.



Map 34 Distribution of *Xanthoparmelia elaeodes* in Australia.

CHEMISTRY. Thallus K−; medulla K−, C−, KC+ rose, P−; containing usnic acid, loxodin, norlobaridone.

DISTRIBUTION. South-eastern Australia (ACT, NSW and SA). Map 34. On rocks in upland areas with moderate rainfall. Specimens examined: 10.

NOTES. Morphologically and chemically this species resembles *X. filarszkyana*. Both lichens are characterised by tightly adnate thalli, broad, subrotund marginal lobes (the upper surface of older lobes often being tangentially cracked), and the production of loxodin and norlobaridone in the medulla. These two taxa differ essentially only in the colour of the lower surface, *X. elaeodes* having a black lower cortex, while in *X. filarszkyana* it is pale brown. *X. elaeodes* has a much more restricted distribution than does *X. filarszkyana*.

X. elaeodes might also be confused with *X. incerta* and *X. everardensis*, since these species are tightly adnate and have subrotund lobes with a black lower surface. However, these species can be readily distinguished chemically since *X. incerta* contains salazinic acid (K+), and *X. everardensis* diffractaic acid (KC−), while *X. elaeodes* contains loxodin and norlobaridone (KC+ rose).

X. elaeodes is a rare species which associates with *X. neotinctina, X. tasmanica, X. notata*, and *X. filarszkyana*.

35. **Xanthoparmelia elixii** Filson

in *Brunonia* **7**: 203 (1984). Type: Australia, South Australia, Mt Lofty Ranges, 3 km north of Carey Gully, 460 m, on rocks in dry sclerophyll forest, 22 May 1976, *J. A. Elix* 2290 (MEL! – holotype; CBG! – isotype).

Illustrations: Galloway in *N.Z. Jl Bot.* **18**: 537 (1981) (as *Parmelia hypoclystoides*); Filson (op. cit.).

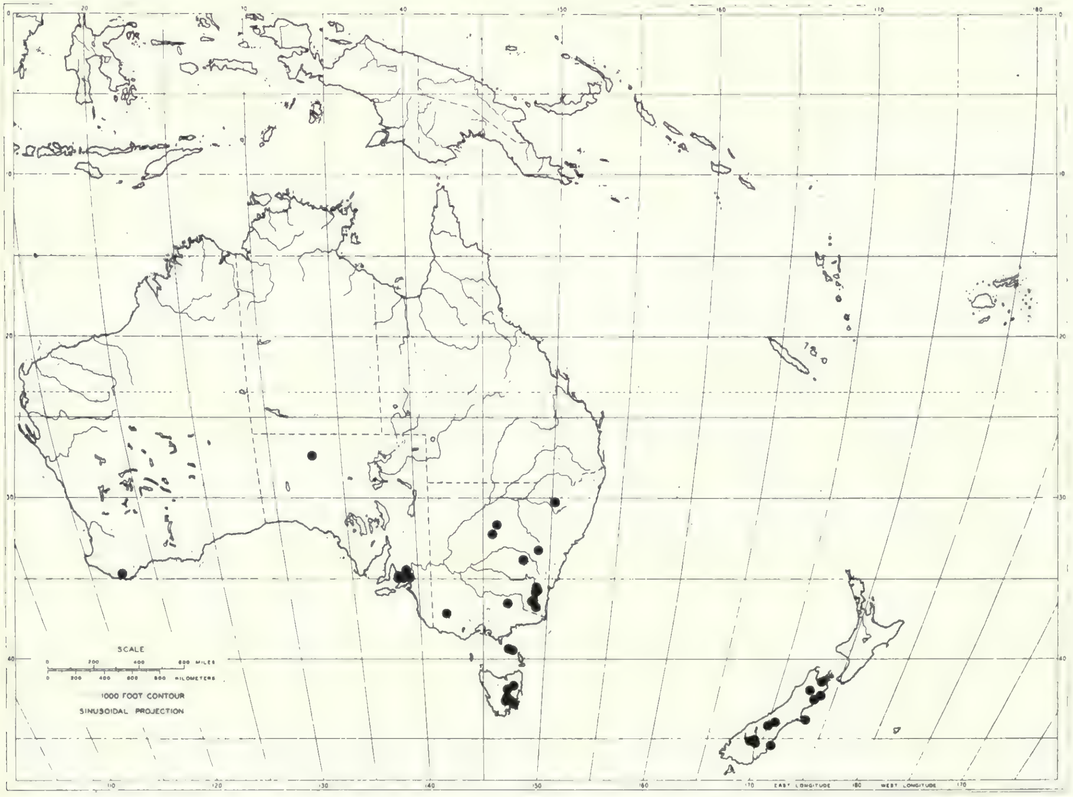
Description. *Thallus* foliose, saxicolous, moderately to loosely adnate to the substrate, yellow-green to olive green, darkening with age, subirregularly lobate, 7–10 cm diam.; *lobes* irregular, 1·5–2·5(–5·0) mm wide, marginally subrotund, secondary lobes narrower than marginal lobes, 0·7–1·5 mm wide, sublinear-elongate, subdichotomously branched, imbricate, sometimes building up thallus into a thick mat. *Upper surface* generally flat, sometimes shining at marginal lobes but becoming dull and wrinkled at centre, emaculate, lobes often with black margins, lacking soredia and isidia; medulla white. *Lower surface* pale ivory to pale brown, sparsely rhizinate, rhizines simple, pale to dark brown, often grouped subapically. *Apothecia* adnate, to 10 mm diam., disc pale to dark brown, deeply concave at first but becoming flattened and distorted, margin thin, inrolled, crenulate, deeply lacerate in older structures; spores 8–9 × 6–7 μm.

Chemistry. Thallus K−; medulla K+ yellow (or yellow becoming red), C−, KC−, P+ yellow; containing usnic acid, norstictic acid (major), salazinic acid (±), connorstictic acid, constipatic acid (±), and protoconstipatic acid (±).

Distribution. Widely distributed in southern Australia (NSW, ACT, Vic, Tas, SA, WA) and South Island, New Zealand. Map 35. On rocks in lowland, mountain, and subalpine habitats. Specimens examined: 86.

Notes. This species was referred to erroneously as *Xanthoparmelia hypoclystoides*, but the taxonomic problems were clarified by Filson (1984).

Xanthoparmelia elixii is characterised by the loosely adnate lobes with a pale lower surface, the common development of narrower, sublinear-elongate secondary lobes which may become highly imbricate (building up the thallus into a thick mat), and the production of norstictic acid, connorstictic acid, and salazinic acid in the medulla.



Map 35 Distribution of *Xanthoparmelia elixii* in Australia and New Zealand.

Morphologically this species resembles *X. flavescentireagens* but differs from it in having shorter, irregularly-divided secondary lobes, coarser rhizines, smaller spores, and in the medullary chemistry. Chemically *X. elixii* is identical with *X. metaclystoides*, but the latter is characterised by tightly adnate, broad lobes, with a moderately to densely rhizinate lower surface. *X. elixii* also resembles *X. arapilensis* and *X. digitiformis* and the distinguishing features of these taxa are discussed under the former two species.

X. elixii is a common species in more temperate areas of southern Australia and also in South Island, New Zealand. It favours rocks in open situations and associates with *Cladia aggregata* (Swartz) Nyl., *Flavoparmelia haysomii* (Dodge) Hale, *Parmelia signifera* Nyl., and other species of *Xanthoparmelia* including *X. tasmanica, X. australasica, X. digitiformis, X. notata, X. neotinctina*, and *X. flavescentireagens*.

36. **Xanthoparmelia eradicata** (Nyl. ex Crombie) Hale

in *Phytologia* **28**: 487 (1974).

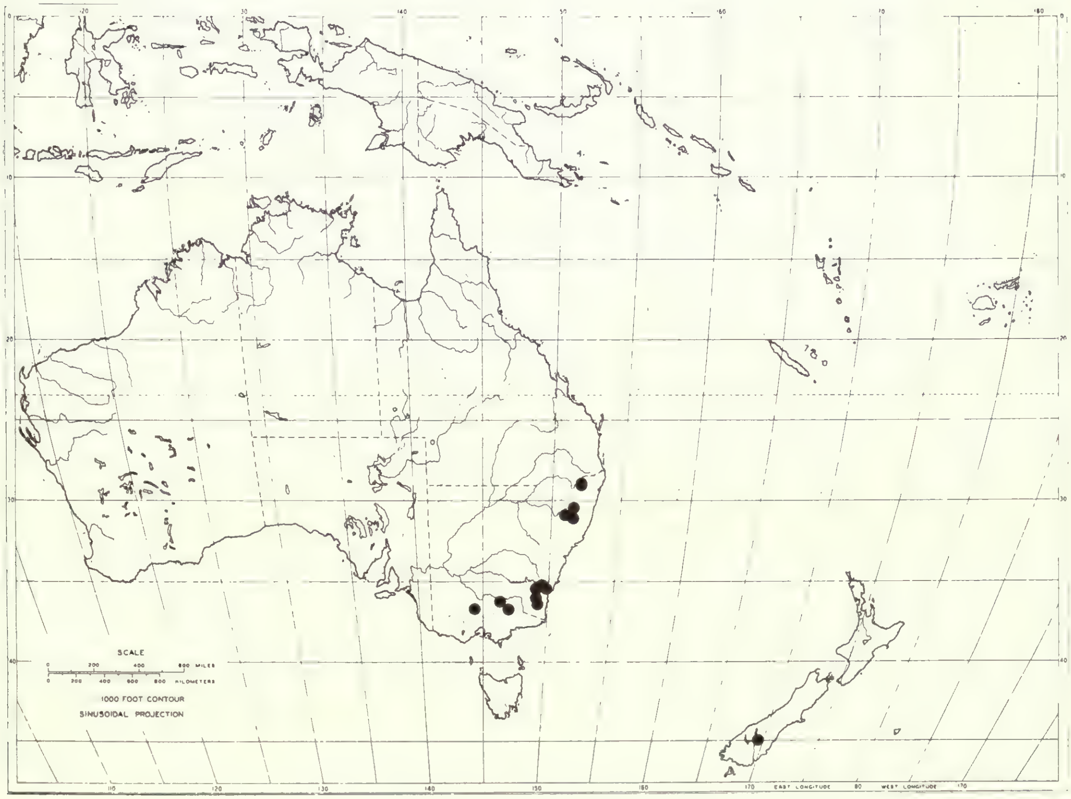
≡ *Parmelia constrictans* var. *eradicata* Nyl. ex Crombie in *J. Bot., Lond.* **14**: 19 (1876). Type: South Africa, Cape Pensinula, Table Mountain, on the summit amongst mosses, September 1874, *A. E. Eaton* (Venus Transit Expedition) (BM! – lectotype).

≡ *Parmelia eradicata* (Nyl. ex Crombie) Gyelnik in *Annls hist.-nat. Mus. natn. hung.* **31** (Bot.): 25 (January 1938).

= *Parmelia rubrireagens* Gyelnik in *Annls mycol.* **36**: 288 (September 1938). Type: Australia, New South Wales, Goulburn, Rocky Hill, face of cliffs, *W. W. Watts* 90 (BP! – holotype).

Illustration: Fig. 16.

DESCRIPTION. *Thallus* foliose, loosely adnate on rocks, yellow-green, blackening with age, 6–10 cm diam.; *lobes* linear-elongate, subdichotomously branched, divaricate in places, moderately



Map 36 Distribution of *Xanthoparmelia eradicata* in Australia and New Zealand.

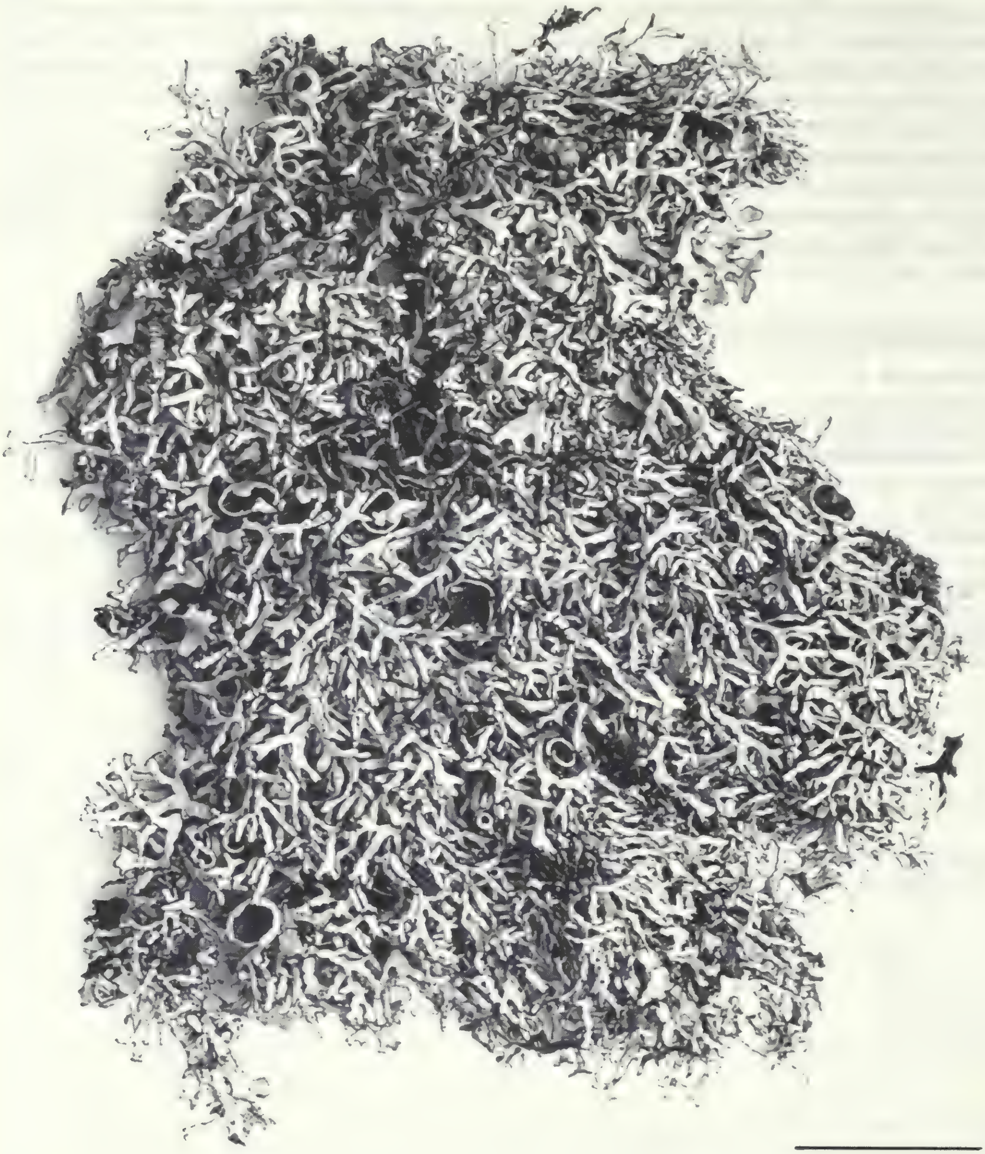


Fig. 16 *Xanthoparmelia eradicata* (Nyl. ex Crombie) Hale. *Elix* 6108 in ANUC. Scale = 1 cm.

imbricate, becoming suberect and exposing black lower surface, 0·5–1·0(–1·5) mm wide. *Upper surface* smooth, shiny, emaculate, lacking soredia and isidia but with numerous pycnidia and black margins; medulla white. *Lower surface* jet black for the most part, wrinkled, with sparse rhizines or rhizines absent, rhizines simple, short, robust. *Apothecia* adnate, 1·0–3·0 mm diam., disc chestnut brown at first, darkening with age, margin entire, thick and involute at first, becoming thin and crenulate with age; spores 7–8 × 5–6 μm.

CHEMISTRY. Thallus K−; medulla K+ yellow becoming dark red, C−, P+ orange; containing usnic acid, salazinic acid, consalazinic acid, and traces of norstictic acid (±).

DISTRIBUTION. Southern and eastern Australia (Qld, NSW, ACT, Vic) and South Island, New

Zealand (Central Otago). Map 36. Also in South Africa. Scattered. On rocks in cooler, upland areas. Specimens examined: 46.

NOTES. *Xanthoparmelia eradicata* belongs to the *X. subnuda* group of species characterised by narrow, linear-elongate lobes, which are di- or trichotomously divided and often ascending at the apices; the lower surface is black, naked or very sparsely rhizinate, and rugulose. This group of species includes *X. multipartita, X. dichotoma, X. suberadicata,* and *X. subnuda*. The status of these species is discussed under *X. multipartita* and a key to the group given under *X. subnuda*. This species also resembles *X. constrictans* both morphologically and chemically; the distinguishing features of these taxa are detailed under the latter species.

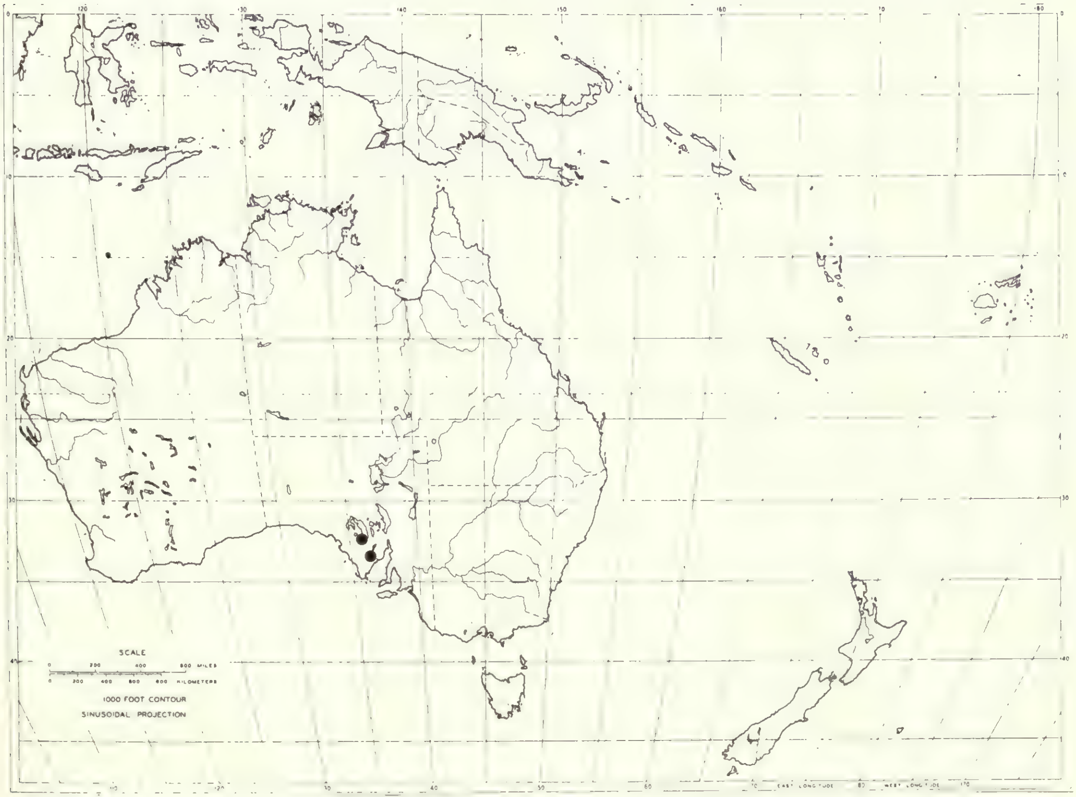
X. eradicata is a relatively common species in the ranges of New South Wales, preferring open saxicolous habitats where it is often found together with *Cladia aggregata* (Swartz) Nyl., *Flavoparmelia haysomii* (Dodge) Hale, *Parmelia signifera* Nyl., *Xanthoparmelia cheelii, X. flavescentireagens, X. notata, X. tasmanica*, and *X. tegeta*.

37. **Xanthoparmelia erosa** (Elix & P. Armstr.) Elix & Jen Johnston, **comb. nov.**

Basionym: *Parmelia erosa* Elix & P. Armstr. in *Aust. J. Bot.* **31**: 472 (1983). Type: Australia, South Australia, Eyre Highway 40 km east of Kimba, loose on surface sand, blowing into low bushes, *R. Filson* 11730a (MEL 1011824! – holotype).

Illustration: Elix & Armstrong (op. cit.).

DESCRIPTION. *Thallus* foliose, unattached on soil, pale yellow-green, darkening in older central lobes, 2–5 cm diam.; *lobes* elongate, convolute, contorted, 3·5–8·0 mm broad when flattened but 1·0–4·0 mm when dry and convoluted. *Upper surface* rugulose and cracked, upper cortex erupting and becoming sorediate, soredia also developing in cracks and fissures, upper cortex



Map 37 Distribution of *Xanthoparmelia erosa* in Australia.

ultimately eroding and extensively covered with granular soredia; medulla white. *Lower surface* pale to dark brown, very sparsely rhizinate, rhizines simple, concolorous with lower surface. *Apothecia* not seen.

CHEMISTRY. Thallus K−; medulla K+ yellow-red, C−, P+ orange; containing usnic acid, salazinic acid, and consalazinic acid.

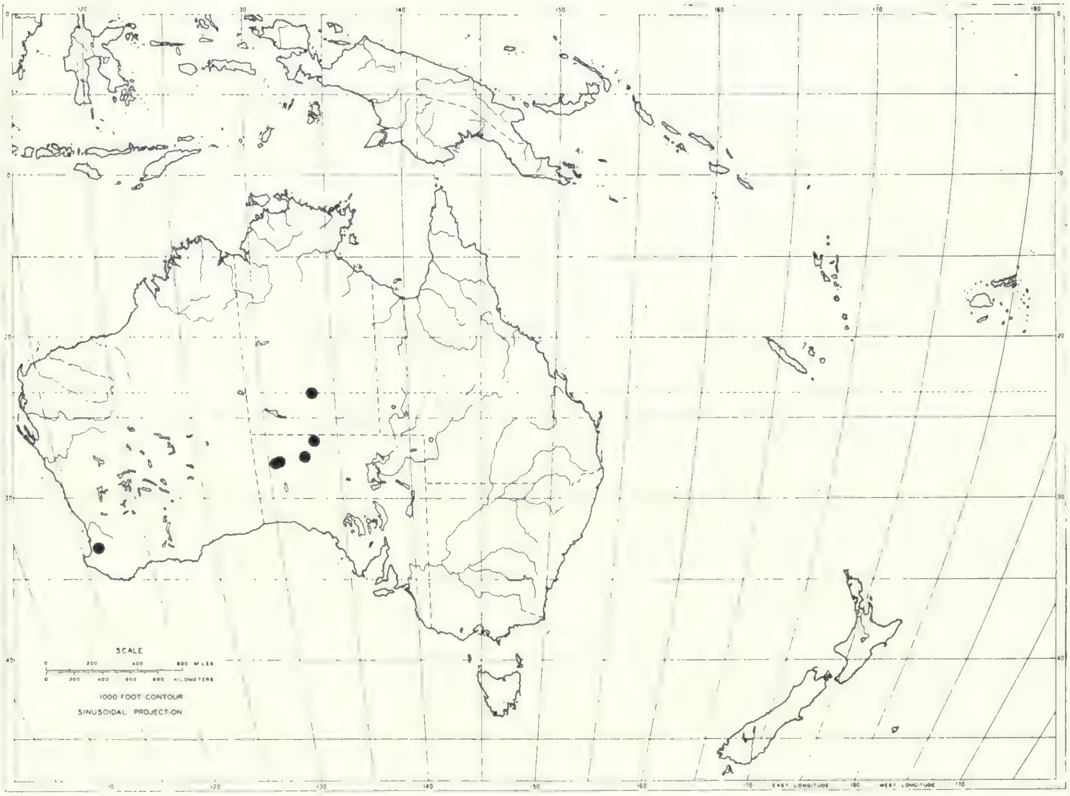
DISTRIBUTION. Eyre Peninsula (SA). Map 37. On soil in subarid shrubland. Specimens examined: 2.

NOTES. This characteristic species is distinguished by the presence of soredia and the convolute-contorted lobes. Morphologically it closely resembles *X. convoluta*, and both species produce salazinic acid, but *X. erosa* is clearly separated by the sorediate upper surface.

38. **Xanthoparmelia everardensis** (Elix & P. Armstr.) Elix & Jen Johnston, **comb. nov.**

Basionym: *Parmelia everardensis* Elix & P. Armstr. in *Aust. J. Bot.* **31**: 473 (1983). Type: Australia, South Australia, Everard Ranges, growing on granite rocks, southern face of Mount Illbillee, 25 November 1975, *R. Filson* 15682 (MEL 1014405! – holotype).
Illustration: Elix & Armstrong (op. cit.).

DESCRIPTION. *Thallus* foliose to subcrustose, adnate to tightly adnate on rocks, to 5 cm diam., yellow-green, darkening with age; *lobes* irregular, contiguous, 1·0–3·0 mm wide, older lobes irregularly fractured and areolae commonly formed. *Upper surface* dull, shiny towards lobe apices, older lobes sometimes with tangential or irregular cracks, lacking soredia and isidia; medulla white. *Lower surface* dark blackish-brown to jet black, sparingly to moderately rhizinate, rhizines black, simple, short. *Apothecia* adnate, 1–2 mm diam., disc dark brown, margin entire, exciple smooth; spores 8–9 × 4–5 μm.



Map 38 Distribution of *Xanthoparmelia everardensis* in Australia.

CHEMISTRY. Thallus K−; medulla K−, C−, KC−, P−; containing usnic acid, atranorin (±), diffractaic acid (major), barbatic acid (minor), and 4-*0*-demethylbarbatic acid (traces).

DISTRIBUTION. North-western SA and south-western WA. Map 38. On rock faces with southerly aspect in arid areas. Specimens examined: 6.

NOTES. Morphologically this species closely resembles *Xanthoparmelia tucsonensis*, and both species contain diffractaic acid as a major metabolite, with smaller quantities of barbatic acid and 4-*0*-demethylbarbatic acid. However, *X. everardensis* is clearly distinguished by the black lower cortex. *X. everardensis* might also be confused with *X. incerta* and *X. elaeodes* since these species are tightly adnate and have subrotund lobes with a black lower surface. For the distinction of these species see *X. elaeodes*.

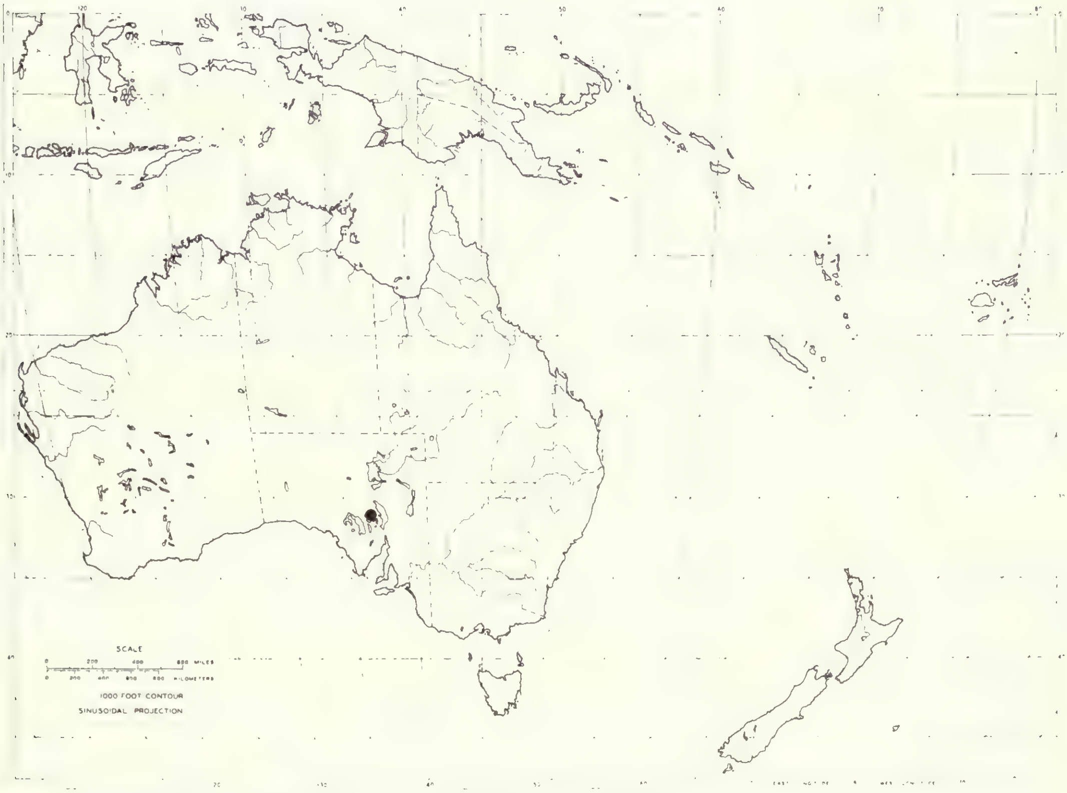
X. everardensis is a rare species known only from the arid north of South Australia and from south-west Western Australia.

39. **Xanthoparmelia examplaris** Elix & Jen Johnston, **sp. nov.**

Thallus ut in *Xanthoparmelia incrustata* sed acidum salazinicum continenti differt. Thallus arcte adnata, lobis superne plus minusve concavis infra canaliculatis, ad centrum lobos vetustos irregulariter separatos et areolas plus minusve magnas formantibus. Superficies inferior straminea vel pallido-brunnea. Thallus 230–315 μm crassus; cortex superior 35–42 μm crassus; stratum gonidiale 35–70 μm crassum; medulla alba, 160–245 μm crassa; cortex inferior 20–35 μm crassus. Thallus K−; medulla K+ flavens deinde rubescens, C−, P+ intense lutescens.

Type: Australia, South Australia, 8 km north of Pimba along the Stuart Highway, on rocks in low chenopod shrubland, 8 September 1983, *J. A. Elix* 11043A & *L. A. Craven* (CBG! – holotype).

Illustration: Fig. 17.



Map 39 Distribution of *Xanthoparmelia examplaris* in Australia.

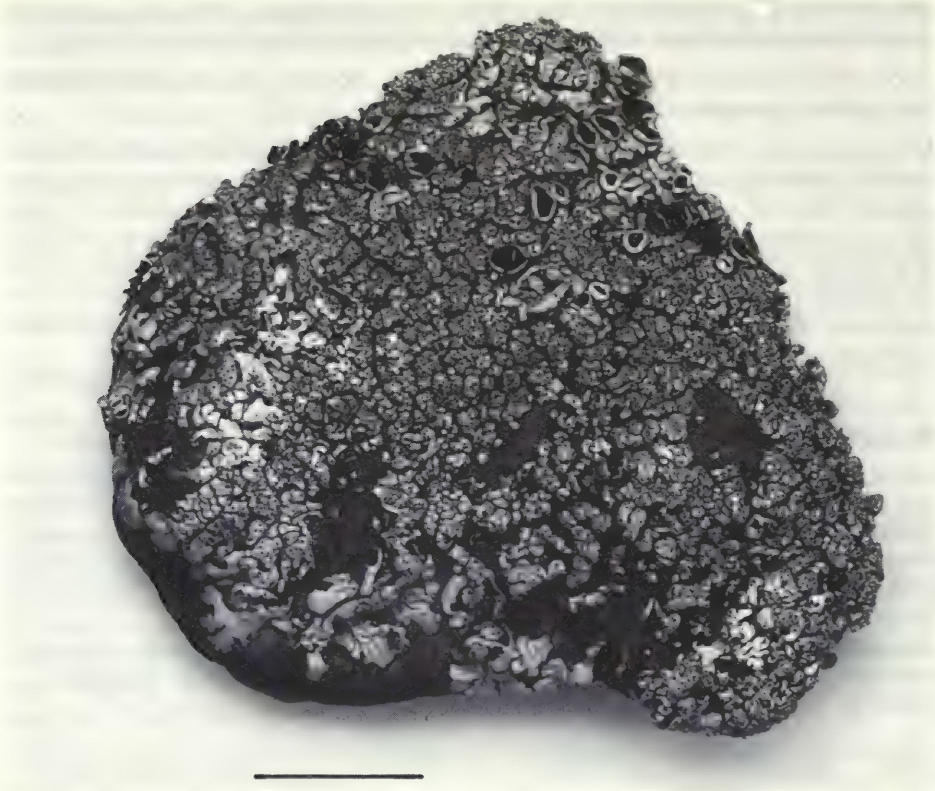


Fig. 17 *Xanthoparmelia examplaris* Elix & Jen Johnston. Holotype in CBG. Scale = 1 cm.

Description. *Thallus* foliose, adnate on rocks, yellow to pale yellow-green, subirregularly lobate, *c.* 5 cm diam.; *lobes* imbricate or not, flat for the most part but some marginal and ± secondary lobes convex, canaliculate below, 0·7–1·5(–3·0) mm wide. *Upper surface* opaque, irregularly cracked, older lobes becoming distinctly rugulose and markedly areolate, lacking soredia and isidia, often with blackened margins at lobe apices, medulla white. *Lower surface* straw-yellow to pale tan, often darkening to grey-black towards lobe apices, sparsely rhizinate, rhizines simple, brown. *Apothecia* subpedicellate, 1–4 mm diam., disc dark brown, deeply concave then ± plane, margin thick, entire, involute at first then becoming thinner, crenulate to deeply incised, exciple smooth; spores 7 × 4·0–5·5 μm.

Chemistry. Thallus K−; medulla K+ yellow-red, C−, P+ intense yellow; containing usnic acid, salazinic acid, consalazinic acid, ± traces of protocetraric acid.

Distribution. Inland SA. Map 39. On rocks in arid shrubland. Specimen examined: 1.

Notes. This species resembles *Xanthoparmelia incrustata* in morphology since both taxa have tightly adnate thalli with a pale lower surface and develop convex marginal and/or secondary lobes with a canaliculate lower surface. However, these species are readily distinguished chemically since *X. incrustata* contains loxodin and norlobaridone in the medulla rather than salazinic acid.

The production of salazinic acid and the canaliculate lobes of *X. examplaris* bring to mind *X versicolor*, for although *X. versicolor* is generally terricolous, it is also found on rocks. Even so, it can readily be distinguished by the colour of the lower surface and the production of lobules. Thus *X. versicolor* has a brown-black lower surface which is paler near the margin, while *X. examplaris* has a yellow to pale tan lower surface which is darker near the margin. Further, *X.*

examplaris is elobulate. Central lobes of this species closely resemble those of *X. lineola*, but the canaliculate marginal and/or secondary lobes clearly distinguish *X. examplaris*.

X. examplaris is a very rare species from inland South Australia where it occurs on pebbles in open chenopod shrubland, growing with *X. incrustata* and *X. pertinax*.

40. Xanthoparmelia exillima (Elix) Elix & Jen Johnston, comb. nov.

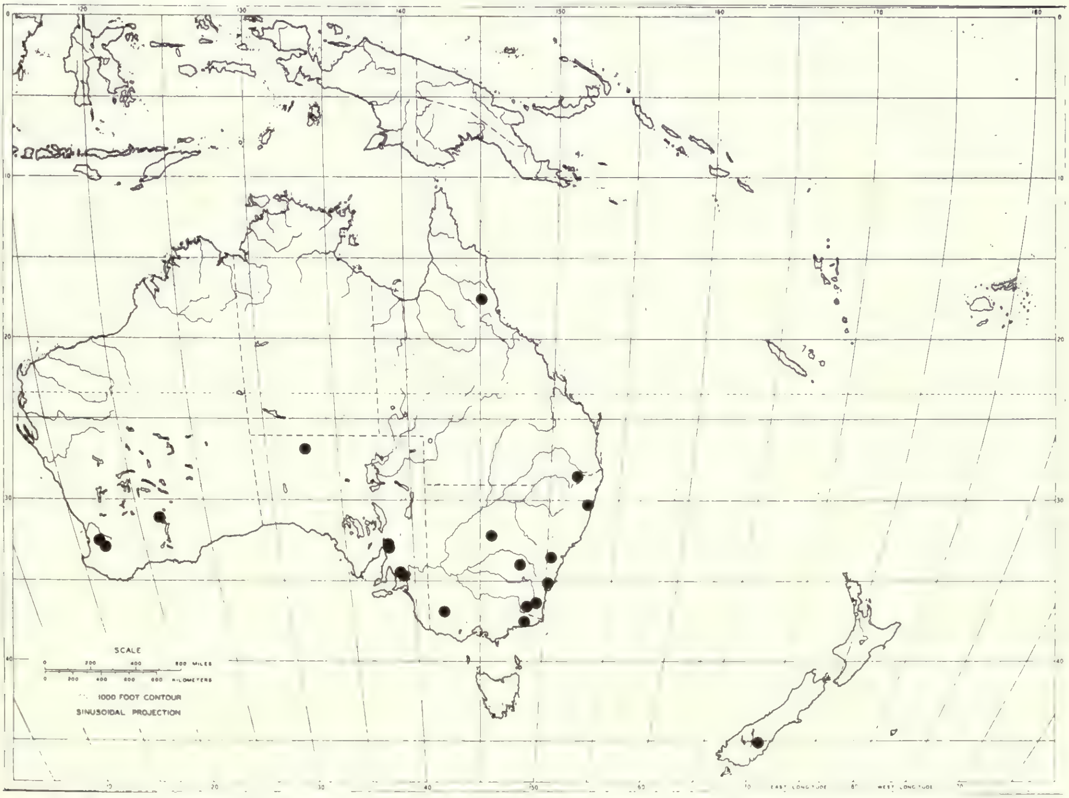
Basionym: *Parmelia exillima* Elix in *Aust. J. Bot.* **29**: 357 (1981). Type: Australia, New South Wales, 13 km south of Countegany along the Nimmitabel road, 1035 m, on granite rocks, *J. A. Elix* 1982 (MEL! – holotype; CANB! – isotype).

Illustration: Elix (op. cit.).

DESCRIPTION. *Thallus* subcrustose, tightly appressed on rocks, yellow-green, darkening with age, subirregularly lobate or commonly becoming almost crustose towards centre, 2–4(–7) cm diam.; *lobes* subirregular to sublinear-elongate, congested, 0·2–0·5 mm wide, plane or convex above. *Upper surface* opaque, emaculate, isidiate, *isidia* cylindrical, simple or commonly branched, often with dark or blackened apices, to 0·3 mm high; medulla white. *Lower surface* yellow-brown to dark brown, sparsely rhizinate, rhizines concolorous with lower surface. *Apothecia* rare, adnate, 1–2 mm diam., disc brown to dark brown, concave at first then ± plane, margin entire then crenate, exciple smooth; spores 7–9 × 4–5·5 μm.

CHEMISTRY. Thallus K−; medulla K−, C−, KC+ rose, P−; containing usnic acid and norlobaridone, loxodin (±), atranorin (±), unknown (±).

DISTRIBUTION. Southern and eastern Australia (Qld, NSW, Vic, SA, WA) and South Island, New Zealand (Central Otago). Map 40. On rocks in open upland areas with moderate rainfall. Specimens examined: 25.



Map 40 Distribution of *Xanthoparmelia exillima* in Australia and New Zealand.

NOTES. Like the common *Xanthoparmelia amplexula*, this species is isidiate (with cylindrical isidia), has lobes with a pale undersurface, and produces usnic acid and norlobaridone. However, *X. amplexula* has adnate to loosely adnate, foliose thalli with much broader (1–3 mm), elongated lobes, while *X. exillima* is subcrustose in part, with very narrow (0·2–0·5 mm), highly congested lobes. Furthermore, *X. exillima* rarely produces loxodin, which always accompanies usnic acid and norlobaridone in *X. amplexula*. For further discussion of the *X. amplexula* complex see the notes under that species.

Morphologically *X. exillima* resembles *X. consociata*, but the latter species usually has somewhat broader lobes with simple isidia and contains usnic, norstictic, and salazinic acids.

An apparently rare, but possibly overlooked species, *X. exillima* occurs in rocky upland areas where it often associates with *Acarospora schleicheri* (Ach.) Massal., *Caloplaca* sp. and the more common *Xanthoparmelia filarszkyana, X. subnuda, X. flavescentireagens*, and *X. scabrosa*.

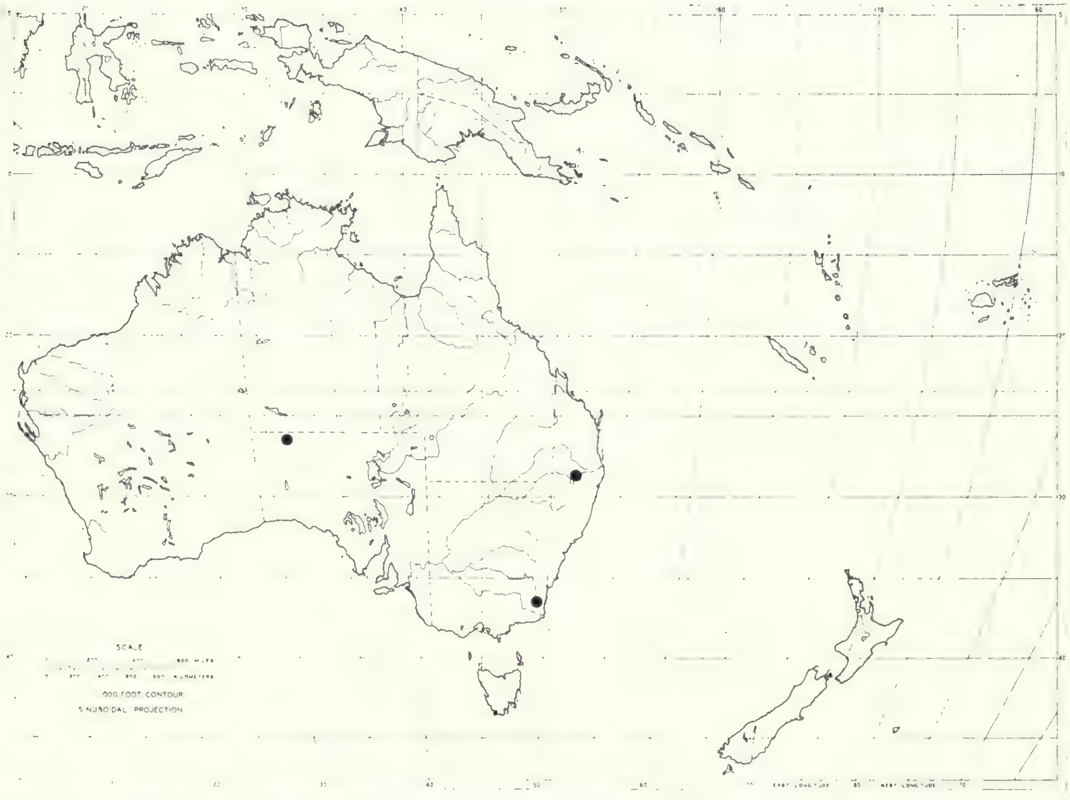
41. **Xanthoparmelia exuviata** (Kurok.) Hale

in *Mycotaxon* **20**: 79 (1984).

≡ *Parmelia exuviata* Kurok. in *Bull. natn. Sci. Mus. Tokyo* B, **8**: 36 (1982). Type: Australia, New South Wales, 15 km east of Cooma on Numeralla Road, *c.* 850 m, *S. Kurokawa* 6449 (TNS – holotype; ANUC! – isotype).

Illustration: Kurokawa (op. cit.).

DESCRIPTION. *Thallus* foliose, adnate on rocks, yellow-green, irregularly lobate, 4–9 cm diam.; *lobes* short, imbricate or not, 1·5–3·0 mm wide. *Upper surface* opaque, emaculate, older lobes becoming rugulose and cracked and ± areolate, upper cortex fragile and occasionally flaking off in places, with numerous isidia, *isidia* simple warty or sparingly branched, cylindrical and ±



Map 41 Distribution of *Xanthoparmelia exuviata* in Australia.

inflated at apices and only rarely erumpent, not at all sorediose; medulla white. *Lower surface* pale brown to brown, sparsely rhizinate, rhizines concolorous with lower surface, 0·1–0·2 mm long. *Apothecia* adnate, 2–3 mm diam., disc brown to dark brown, exciple isidiate; no mature spores observed.

CHEMISTRY. Thallus K−; medulla K−, C−, KC−, P−; containing usnic acid and the unidentified aliphatic acids, exuviatic acid A and exuviatic acid B.

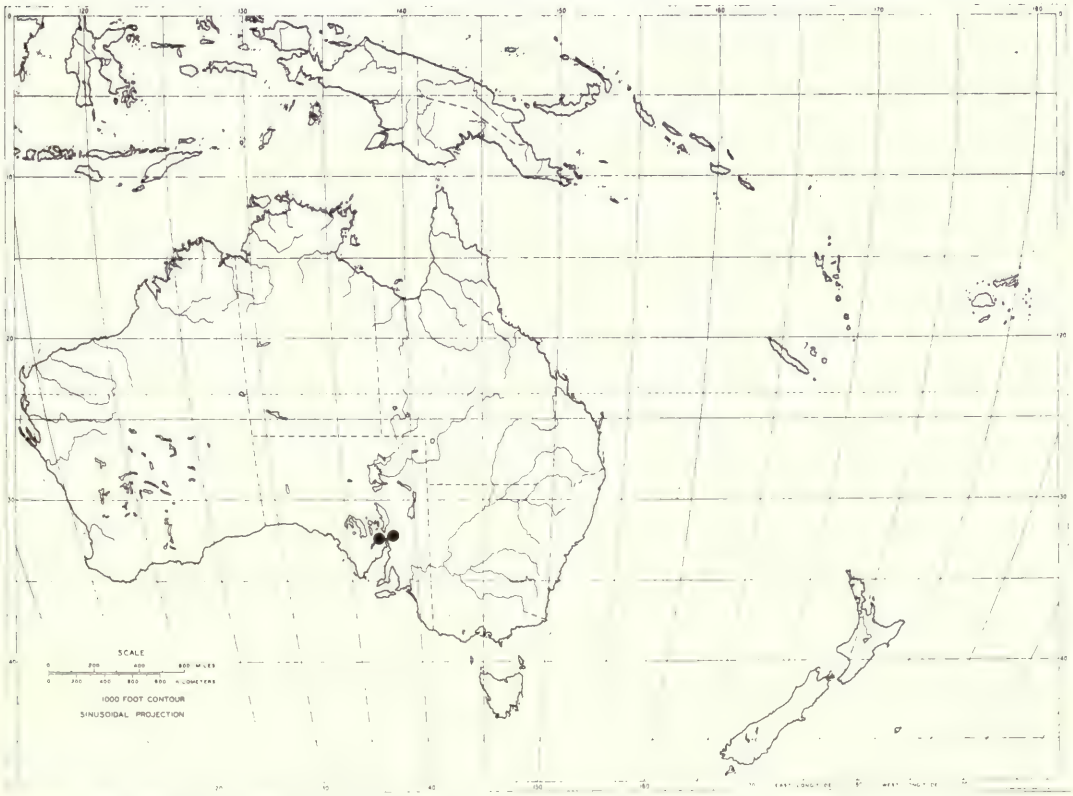
DISTRIBUTION. Rare in eastern and central Australia (Qld, NSW, SA). Map 41. On rocks in upland regions in arid, subarid, or areas of moderate rainfall. Specimens examined: 7.

NOTES. This species resembles *Xanthoparmelia scabrosa* in having inflated isidia and lobes with a pale lower surface. However, in *X. exuviata* the isidia only rarely burst open and do not become sorediate as they do in *X. scabrosa*. These two species are readily distinguished chemically since *X. exuviata* lacks the loxodin and norlobaridone characteristic of *X. scabrosa*. Instead, *X. exuviata* produces only usnic acid together with exuviatic acid A and exuviatic acid B (aliphatic acids of unknown structure). A characteristic morphological feature of some specimens of *X. exuviata* appears to be the fragility of the upper cortex and associated algal layer which often flakes off exposing the white medullary layer.

A rare species, *X. exuviata* associates with other species of *Xanthoparmelia* including *X. scabrosa, X. mexicana, X. flavescentireagens, X. tasmanica, X. reptans,* and *X. filarszkyana*.

42. **Xanthoparmelia ferruma** Elix & Jen Johnston, **sp. nov.**

Thallus ut in *Xanthoparmelia lineola* sed medulla inferiore aurantiacam et skyrinum continenti differt. Thallus arcte adnata, superficie inferiore brunnea vel fusca, modice rhizinata, rhizinis concoloris, simplicibus. Thallus 155–175 μm crassus; cortex superior 17–28 μm crassus, stratum gonidiale 25–30 μm



Map 42 Distribution of *Xanthoparmelia ferruma* in Australia.

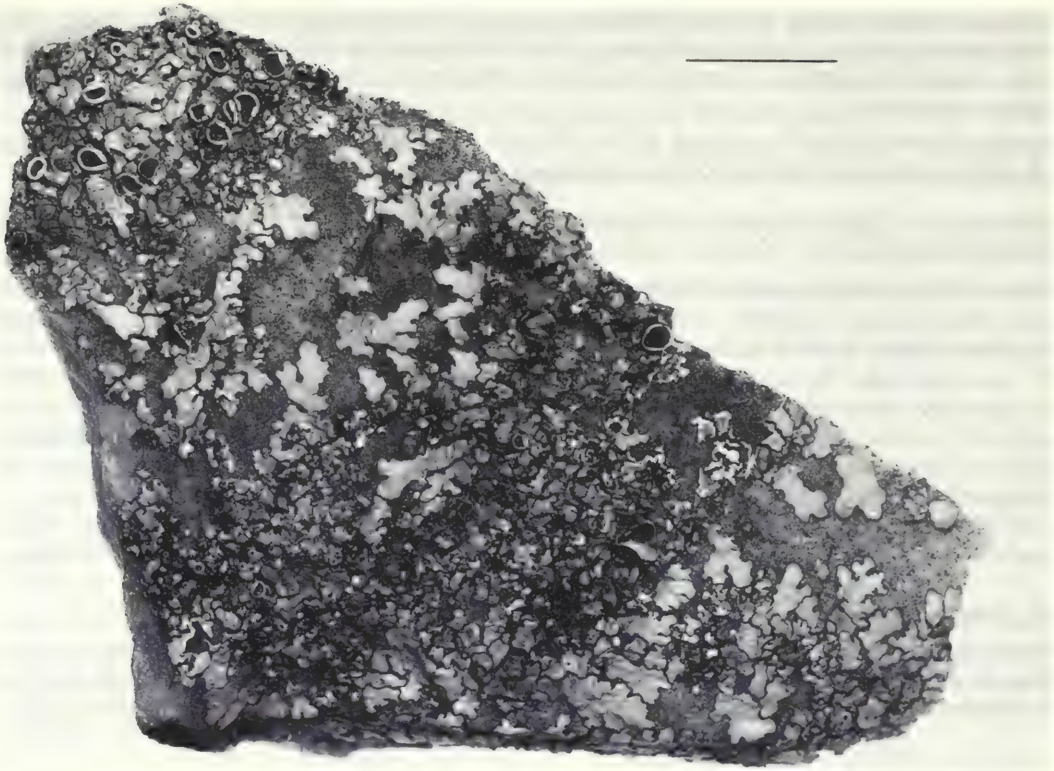


Fig. 18 *Xanthoparmelia ferruma* Elix & Jen Johnston. Portion of holotype in US. Scale = 1 cm.

crassum, medulla 80–125 μm crassa, cortex inferior 7–10 μm crassus. Thallus K−; medulla K+ primum flavens deinde rubescens, C−, P+ intense lutescens; acidum usnicum, acidum salazinicum and skyrinum continens.

Type: Australia, South Australia, 13 km south-west of Quorn on the Port Augusta road, on granite batholith along dry creek, 17 January 1982, *M. E. Hale* 58373 (US! – holotype).
Illustration: Fig. 18.

Description. *Thallus* foliose, tightly adnate on rocks, *c.* 5 cm wide, pale yellow-green, blackening with age, subirregularly lobate, barely imbricate; lobes irregular to sublinear-elongate, marginal lobes subrotund, older lobes with tangential cracks, 1·0–2·0(–3·0) mm wide. *Upper surface* opaque, flat, emaculate; *lobes* often with a black margin, older central lobes becoming wrinkled, and developing tangential or irregular cracks, lacking soredia and isidia; medulla white for the most part but here and there orange pigmented adjacent to lower cortex. *Lower surface* brown to brown-black, moderately rhizinate, rhizines short, slender, concolorous with the lower surface, simple. *Apothecia* adnate, 1–2 mm diam., margin thick and involute at first, then thin and undulate, disc brown-black, concave then ± flat, exciple smooth; spores 7–9 × 4·5–5·5 μm.

Chemistry. Thallus K−; medulla K+ yellow becoming red (pigmented area K+ violet), C−, P+ intense yellow; containing usnic acid, salazinic acid, skyrin, consalazinic acid, traces of protocetraric acid (±).

Distribution. Inland SA. Map 42. On rocks in a subarid area. Specimens examined: 2.

Notes. This species belongs to the *Xanthoparmelia lineola* group, species which are characterised by their tightly adnate thalli, broad, rotund marginal lobes, a pale lower surface, and by the upper surface of older lobes often being tangentially cracked. For a detailed discussion of the group refer to notes under *X. barbatica*, and the key under *X. lineola*.

Xanthoparmelia ferruma is distinguished from all other members of this group by the pigmented lower medulla, and, although it also contains salazinic acid as does *X. lineola* itself, the lobes of *X. ferruma* are more or less irregular, while those of *X. lineola* are definitely linear-elongate. More obvious is the colour of the lower cortex, being pale tan in *X. lineola*, but dark brown to brown-black in *X. ferruma*.

This species was discovered by Dr M. E. Hale and we thank him for bringing it to our attention. It appears to be a very rare species and is only known from two localities in South Australia. The original collection is from Iron Knob and the species name is based on that locality.

43. **Xanthoparmelia filarszkyana** (Gyelnik) Hale

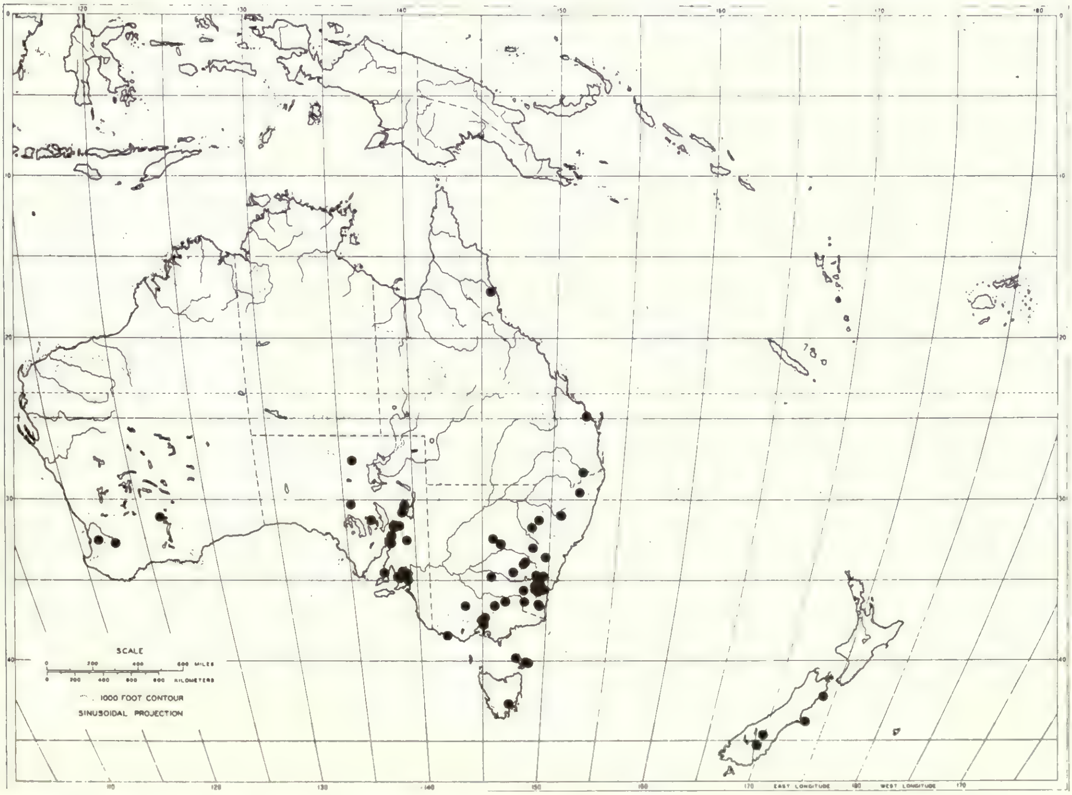
in *Phytologia* **28**: 487 (1974).

≡ *Parmelia filarszkyana* Gyelnik in *Annls mycol.* **36**: 278 (1938). Type: Australia, New South Wales, Tamworth, Ogunbil, Round Swamp, *W. Gardner* (BP! – holotype).

= *Parmelia praetermissa* Kurok. & Filson in *Bull. nat. Sci. Mus. Tokyo* B, **1**: 41 (1975). Type: Australia, South Australia, growing on rock in exposed position on rocky hillside, Olive Grove Station, 14·5 km south of Quorn, *R. Filson* 11995 (MEL 1011717! – holotype; TNS – isotype).

Illustration: Kurokawa & Filson (op. cit., as *P. praetermissa*).

DESCRIPTION. *Thallus* tightly adnate on rocks, 6–8 cm wide, pale yellow-green, darkening with age, subirregularly lobate, barely imbricate; *lobes* irregular, marginal lobes rotund, older lobes with tangential cracks and becoming areolate, 1·0–3·0 mm wide. *Upper surface* opaque, flat, emaculate, lobes often with black margins, older central lobes becoming wrinkled, dull, blackened and developing tangential or irregular cracks, lacking soredia and isidia; medulla white. *Lower surface* pale tan to brown, blackening near lobe apices, moderately rhizinate, rhizines short, slender, concolorous with lower surface, simple. *Apothecia* adnate, 2–10 mm



Map 43 Distribution of *Xanthoparmelia filarszkyana* in Australia and New Zealand.

diam., disc dark brown, deeply concave and then ± plane, margin entire, undulating, exciple smooth; spores 8–10 × 5–6 μm.

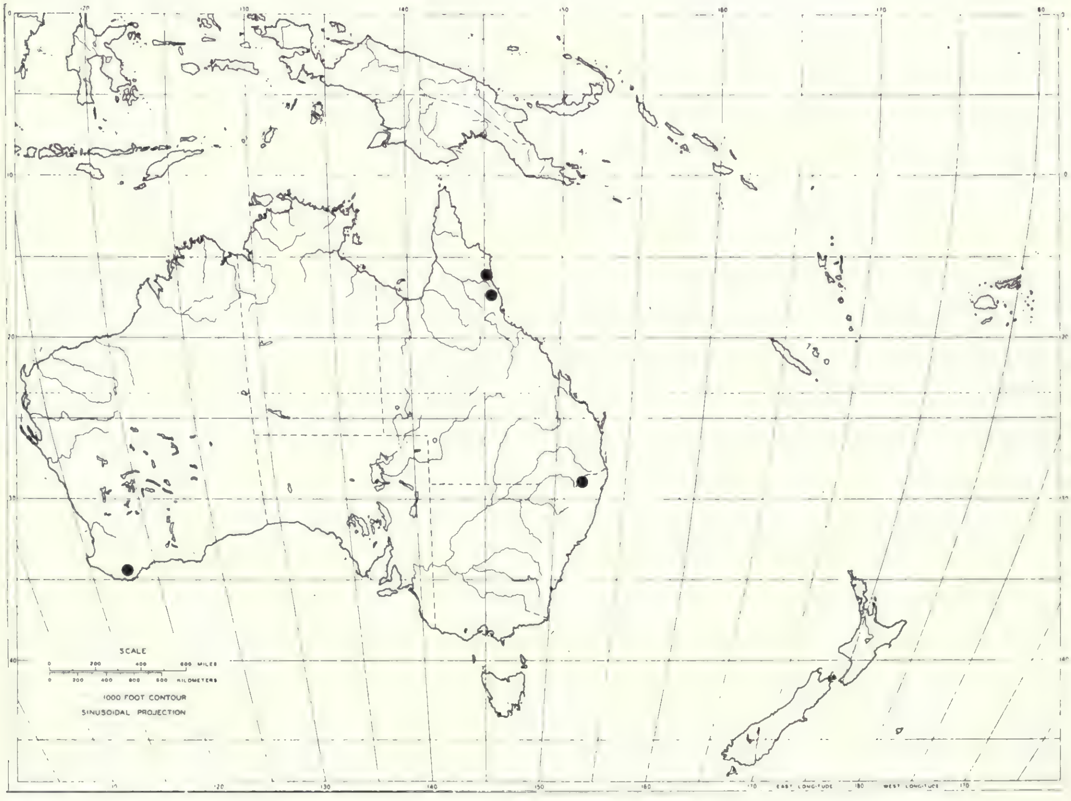
Chemistry. Thallus K−; medulla K−, C−, KC+ rose, P−; containing usnic acid, loxodin (±), norlobaridone, protoconstipatic acid (±), constipatic acid (±) and rarely traces of conorlobaridone (±), conloxodin (±).

Distribution. Southern and eastern Australia (Qld, NSW, ACT, Vic, Tas, SA, WA) and South Island, New Zealand. Map 43. On rocks in arid, subarid, and hinterland areas of moderate rainfall. Specimens examined: 126.

Notes. *X. filarszkyana* belongs to the *X. lineola* group, species of which are characterised by tightly adnate thalli, broad rotund marginal lobes, a pale lower surface, and by the upper surface of older lobes often being tangentially cracked. For a detailed discussion of this group, see under *X. barbatica* and *X. lineola*.

X. filarszkyana was also confused with *X. flavescentireagens*, but the latter species is loosely adnate and generally has well-developed, imbricate, subdichotomously divided, linear-elongate secondary lobes in contrast to the tightly adnate thallus of *X. filarszkyana*, with barely imbricate, subirregular, broad lobes with rotund or subrotund apices. In several areas, however, these two species do appear to intergrade.

X. filarszkyana is a widespread and common species in Australia (less so in New Zealand) and typical associates in wetter areas include *X. lineola, X. scabrosa, X. neotinctina, X. amplexula, X. furcata*, and *X. elixii*. In more arid situations co-occurring lichens include *Acarospora schleicheri* (Ach.) Massal., *Caloplaca* sp., *Xanthoparmelia lineola, X. mexicana*, and *X. incrustata*.



Map 44 Distribution of *Xanthoparmelia filsonii* in Australia.

44. Xanthoparmelia filsonii Elix & Jen Johnston, sp. nov.

Thallus ut in *Xanthoparmelia mougeotina* sed adnatus, lobis imbricatis et acidum norsticticum et acidum connorsticticum continenti etiam differt. Thallus parvofoliosus fere subcrustosus, superficie inferiore nigrescenti. Thallus 95–115 μm crassus; cortex superior 17–20 μm crassus, stratum gonidiale 7–20 μm crassum, medulla 45–70 μm crassa, cortex inferior 10–20 μm crassus. Thallus K−; medulla K+ lutea deinde aurantiaco-rubescens, C−, P+ lutea.

Type: Australia, Queensland, 1 km south-west of Herberton, 17°23′S, 145°21′E, 1180 m, on quartz rocks in old mullock heaps, 27 June 1984, *J. A. Elix* 16639 & *H. Streimann* (CBG! – holotype).
Illustration: Fig. 19.

DESCRIPTION. *Thallus* small-foliose, adnate on rocks, yellow-green, darkening with age, radiating at first but eventually becoming irregularly lobate, 5–7 cm diam.; *lobes* imbricate, sublinear-elongate, 0·2–0·8(–1·0) mm wide, often developing finely divided, subascending secondary lobes (0·1–0·4 mm wide) at centre. *Upper surface* shiny, at least near the apices, emaculate, isidiate, *isidia* cylindrical, scattered at first but becoming dense and branched in older parts of thallus; medulla white. *Lower surface* black, shiny, sparsely rhizinate, rhizines short, simple, black. *Apothecia* not seen.

CHEMISTRY. Thallus K−; medulla K+ yellow then reddish, C−, P+ intense yellow; containing usnic acid, norstictic acid, connorstictic acid.

DISTRIBUTION. Hinterland areas of Qld and southwest WA. Map 44. Specimens examined: 4.

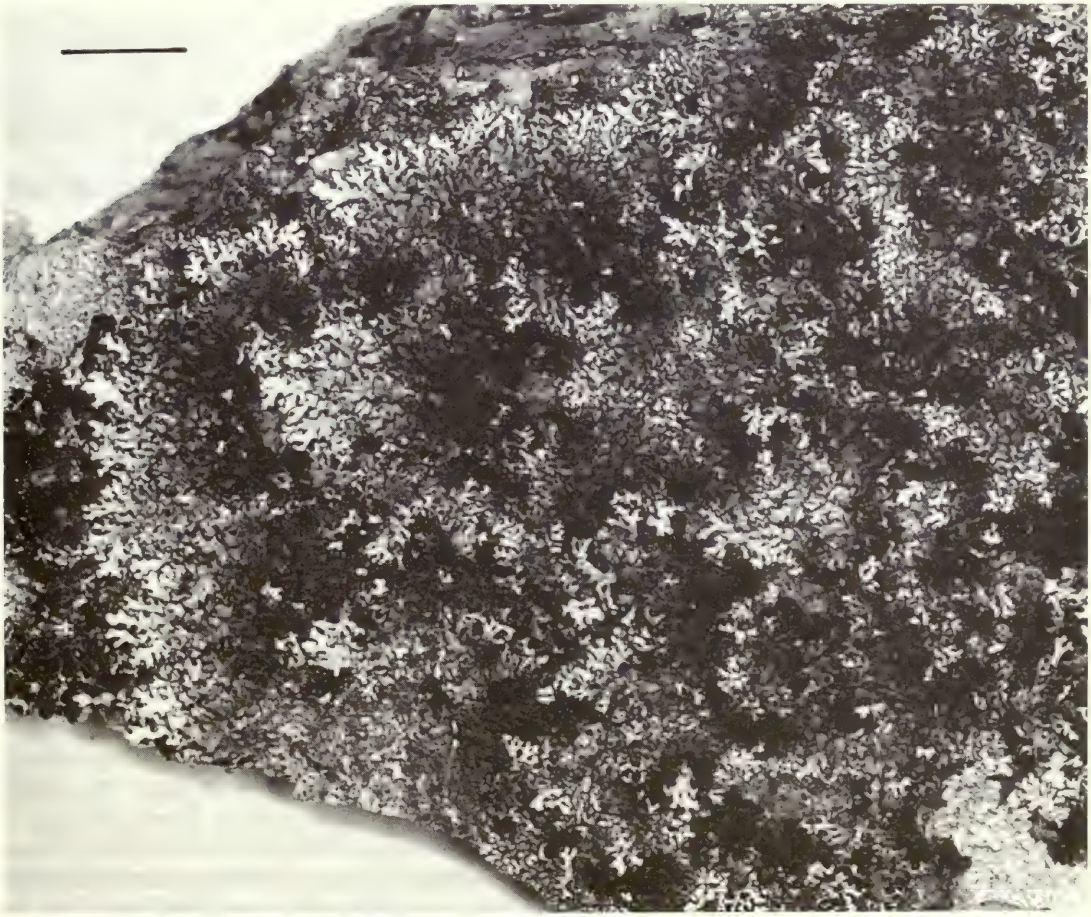


Fig. 19 *Xanthoparmelia filsonii* Elix & Jen Johnston. Portion of holotype in CBG. Scale = 0·5 cm.

NOTES. This species is characterised by the moderately adnate thalli, the narrow, diminutive lobes with a black lower surface, and by the presence of cylindrical isidia.

Morphologically this species resembles *Xanthoparmelia mougeotina* with its similar diminutive isidiate lobes with a black lower surface. *X. filsonii* is distinguished by the thalli being more loosely adnate and by the secondary lobes becoming subascending in the centre of the thallus.

Chemically *X. mougeotina* produces usnic acid and stictic acid as major secondary metabolites with minor quantities of constictic acid, norstictic acid, and traces of cryptostictic acid (i.e. the stictic acid complex). *X. filsonii* is distinct chemically, since it produces only usnic acid, norstictic acid, and connorstictic acid.

The presence of isidia, the black undersurface of the lobes, and the production of norstictic acid also bring to mind *X. alexandrensis* and *X. neotinctina*. However *X. alexandrensis* is distinguished by having erumpent isidia and broader, loosely adnate lobes, while *X. neotinctina* has a larger thallus with broad lobes (1·0–4·0 mm wide), which do not become finely dissected nor subascending as do the secondary lobes of *X. filsonii*. Further, *X. filsonii* lacks salazinic acid, which is normally present in substantial quantities in *X. neotinctina*.

X. filsonii is best known from Queensland where it occurs on dry rock surfaces in the Great Dividing Range. Common associates include *X. adhaerens, X. amplexula, X. mougeotina,* and *X. tasmanica*.

This species is named in honour of one of Australia's foremost lichenologists, Rex B. Filson, of the National Herbarium of Victoria.

45. **Xanthoparmelia flavescentireagens** (Gyelnik) D. Galloway

in *N.Z. Jl. Bot.* **18**: 533 (1981).

≡ *Parmelia flavescentireagens* Gyelnik in *Reprium Spec. nov. Regni veg.* **36**: 154 (1934). Type: Australia. New South Wales (now Australian Capital Territory), Booroomba Rocks. February 1906, *G. H. Barker* (BP! – holotype).

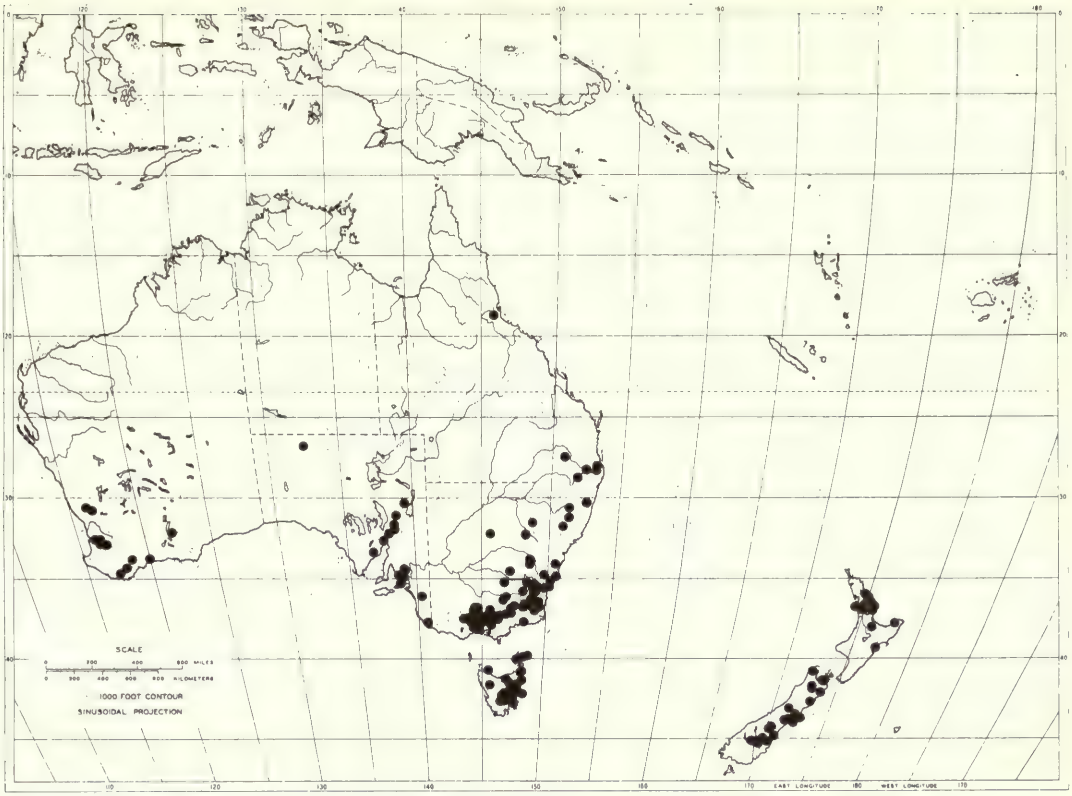
Illustrations: Galloway (op. cit.); Filson & Rogers, *Lichens South Australia*; plate 11c (1979) (as *Parmelia furcata*).

DESCRIPTION. *Thallus* foliose, saxicolous or spreading over soil, moderately to loosely adnate, pale yellow to yellow-green, darkening with age, to 15 cm diam.; *lobes* very variable, irregular with rotund apices to sublinear-elongate, 1·5–2·5(–10 mm) wide, secondary lobes narrower than marginal lobes, 0·8–1·5 mm wide, subdichotomously branched, imbricate, sometimes building up the thallus into a thick mat. *Upper surface* slightly convex, shiny, emaculate, lobes often with black margins, lacking soredia and isidia; medulla white. *Lower surface* pale ivory to brown, darker towards apices where it is commonly blackened, moderately rhizinate, rhizines short, slender, concolorous with lower surface, often grouped subapically. *Apothecia* deeply concave, pale brown, margin thin, crenulate, deeply incised, exciple smooth; spores 11–14 × 5–7 μm.

CHEMISTRY. Thallus K−; medulla K−, C−, KC+ rose, P−; containing usnic acid, loxodin, norlobaridone and as accessory metabolites constipatic acid (±), protoconstipatic acid (±), scabrosin 4,4′-diacetate (±), scabrosin 4-acetate-4′-butyrate (±), scabrosin 4-acetate-4′-hexanoate (±) and scabrosin 4,4′-dibutyrate (±), conloxodin (±), conorlobaridone (±).

DISTRIBUTION. Very common in southern and eastern Australia (Qld, NSW, ACT, Vic, Tas, SA, and WA) and New Zealand. Map 45. On rocks, pebbles, soil, and rarely dead wood from sea-level to 2000 m. Specimens examined: 366.

NOTES. This species is characterised by the production of loxodin and norlobaridone, loosely adnate lobes with an ivory to pale brown lower surface and an absence of isidia. Specimens dominated by attenuate, subdichotomously divided secondary lobes are often confused with *X. furcata* but are distinguished by the slender, moderately dense rhizines which are often grouped subapically, the ivory to pale brown lower surface, and the fact that the lobes appear constricted (i.e. of irregular width). In *X. furcata* on the other hand, the spores are much smaller, the rhizines are sparse but robust, the lower surface pale to chocolate brown, and the lobes of



Map 45 Distribution of *Xanthoparmelia flavescentireagens* in Australia and New Zealand.

uniform width or tapering slightly towards the apices. Occasionally these two species are difficult to distinguish and in several areas appear to intergrade.

Alpine specimens of *X. flavescentireagens* often have a darker brown lower surface which becomes black-brown towards the apices, but this is considered to be an environmental modification. In such cases the upper surface also shows a similar darkening of the lobes, while the lower surface of the central lobes is invariably pale ivory in colour.

This species was also confused with *X. filarszkyana*, but this has subirregular, broad lobes with subrotund apices which are tightly adnate to the substrate (albeit that this species is chemically identical with *X. flavescentireagens*).

Morphologically *X. flavescentireagens* also resembles *X. elixii* and *X. digitiformis*, but these latter species differ chemically (both K+ yellow-red) and do not become dominated by the loose, subdichotomously divided secondary lobes so common in *X. flavescentireagens*.

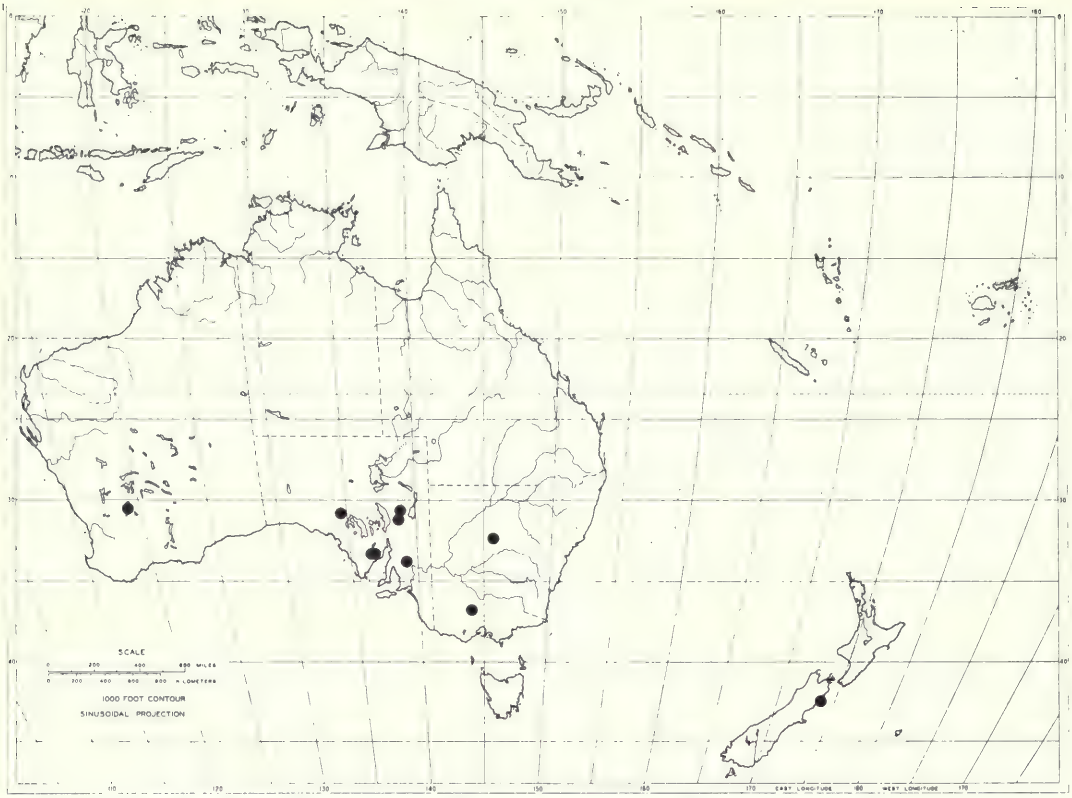
This is a ubiquitous and variable species throughout southern Australia and New Zealand. Common associates include *Cladia aggregata* (Swartz) Nyl., and other species of *Xanthoparmelia*, particularly *X. scabrosa, X. tasmanica,* and *X. substrigosa*.

46. **Xanthoparmelia flindersiana** (Elix & P. Armstr.) Elix & Jen Johnston, **comb. nov.**

Basionym: *Parmelia flindersiana* Elix & P. Armstr. in *Aust. J. Bot.* **31**: 474 (1983). Type: Australia, South Australia, Flinders Ranges, on rocks along road to Artimore, 1·5 km from Narrina River, 17 November 1975, *R. Filson* 15570 and *S. Filson* (MEL 1014509! – holotype).

Illustration: Elix & Armstrong (op. cit.).

Description. *Thallus* foliose, tightly adnate to rocks, yellow-green, blackening with age, 2–8 cm diam.; *lobes* sublinear-elongate to irregular, imbricate or not, 1·0–2·0(–5) mm wide, apices rounded or shallowly notched. *Upper surface* shining, emaculate, smooth at margins, becoming



Map 46 Distribution of *Xanthoparmelia flindersiana* in Australia and New Zealand.

wrinkled or often tangentially or irregularly cracked, older lobes becoming rugulose and eventually areolate, margins ± blackened, isidiate, isidia laminal in centre of thallus, globose at first, then inflated at apices and ± erupting but not sorediose, simple; medulla white. *Lower surface* pale to light brown, darker at apices, shining, moderately to sparsely rhizinate, rhizines short, simple, concolorous with lower surface. *Apothecia* adnate, *c.* 1 mm diam. (immature), disc dark brown, exciple isidiate; no mature spores observed.

CHEMISTRY. Thallus K−; medulla K+ yellow then red, C−, P+ intense yellow; containing usnic acid, norstictic acid and connorstictic acid, ± traces of hypostictic acid, and hyposalazinic acid.

DISTRIBUTION. Inland NSW, Vic, SA, WA and South Island, New Zealand (Marlborough). Map 46. On rocks in subarid and arid areas, and on coastal rocks. Specimens examined: 24.

NOTES. In overall appearance this species resembles *Xanthoparmelia mexicana* and *X. cordillerana* in having broad lobes, a pale lower surface, and isidia. However, *X. flindersiana* is more tightly adnate than *X. cordillerana*, although both species have erumpent isidia or dactyls. *X. mexicana* is often tightly adnate but has normal cylindrical isidia. *X. mexicana* and *X. cordillerana* contain salazinic acid in the medulla, while *X. flindersiana* contains norstictic acid and connorstictic acid.

X. flindersiana is widely dispersed on loose pebbles in subarid areas; it is associated with *X. lineola, X. flavescentireagens, X. mexicana, X. scabrosa,* and *X. arapilensis.*

47. **Xanthoparmelia furcata** (Müll. Arg.) Hale

in *Phytologia* **28**: 487 (1974).

≡ *Parmelia furcata* Müll. Arg. in *Flora, Jena* **69**: 256 (1886). Type: Australia, New South Wales, *L. Leichardt* (G! – holotype; M! – isotype).

= *Parmelia foliosa* Krempelh. ex Gyelnik in *Annls hist.-nat. Mus. natn. hung.* **29** (Bot.): 35 (1935). Type: Australia, New South Wales, *L. Leichardt* (W! – holotype; MEL 5935! – isotype; M! – isotype).

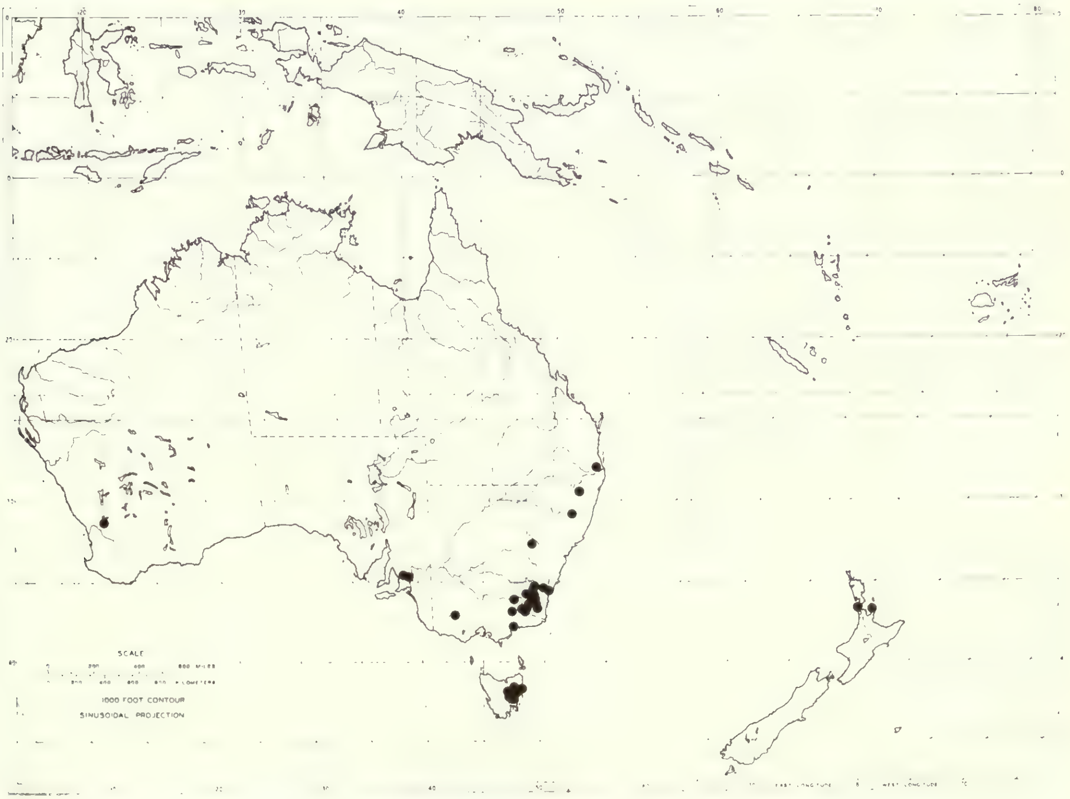
Illustration: Galloway in *N.Z. Jl. Bot.* **18**: 534, 535 (1981).

DESCRIPTION. *Thallus* foliose, saxicolous, loosely attached to the substrate, yellow-green in colour, 5–10 cm diam. *Lobes* linear-elongate, 0·5–1·5 mm wide, up to 8 mm long, divaricate, with subregular dichotomous branching, margins shining, black or brown, often subascending at apices exposing lower surface. *Upper surface* smooth, shining or opaque, emaculate, lacking soredia and isidia; medulla white. *Lower surface* pale brown to chocolate brown, always darker to almost black near apices, shining or matt, wrinkled, very sparsely rhizinate, rhizines concolorous with lower surface, simple, robust. *Apothecia* to 5 mm diam., disc brown to dark brown, margin thin, involute, crenulate, incised; spores 6–8 × 4·5–5·5 μm.

CHEMISTRY. Thallus K−; medulla K−, C−, KC+ rose, P−; containing usnic acid, loxodin, norlobaridone and rarely traces of conorlobaridone (±), norlobariol methyl ester (±).

DISTRIBUTION. Southern and eastern Australia (Qld, NSW, ACT, Vic, Tas, SA, WA) and North Island, New Zealand (Central Auckland). Map 47. On rocks in coastal, upland, and subalpine zones. Specimens examined: 70.

NOTES. This species is characterised by narrow, linear-elongate, dichotomously branching lobes and a brown, rugulose lower surface with sparse but robust rhizines. Morphologically *X. furcata* comes close to *X. dichotoma*, and these two taxa differ essentially only in the colour of the lower surface. *X. dichotoma* has a lower surface which is black throughout, or occasionally brown or chocolate brown towards the apices, while *X. furcata* has a brown lower surface which is dark brown or black at the apices. In general, the lobes of *X. dichotoma* also are more linear-elongate than those of *X. furcata*. Furthermore, these species have different ecological requirements, *X.*



Map 47 Distribution of *Xanthoparmelia furcata* in Australia and New Zealand.

dichotoma favouring moist rocks, particularly where run-off water drains or collects, while *X. furcata* is found on dry, well-drained rock surfaces.

X. furcata is commonly confused with *X. flavescentireagens*; for the distinction of these taxa refer to the discussion under the latter species. *X. metamorphosa* also resembles *X. furcata* in many respects, being chemically identical and having a pale lower surface. *X. metamorphosa* is distinguished by the narrower lobes and maculate upper surface.

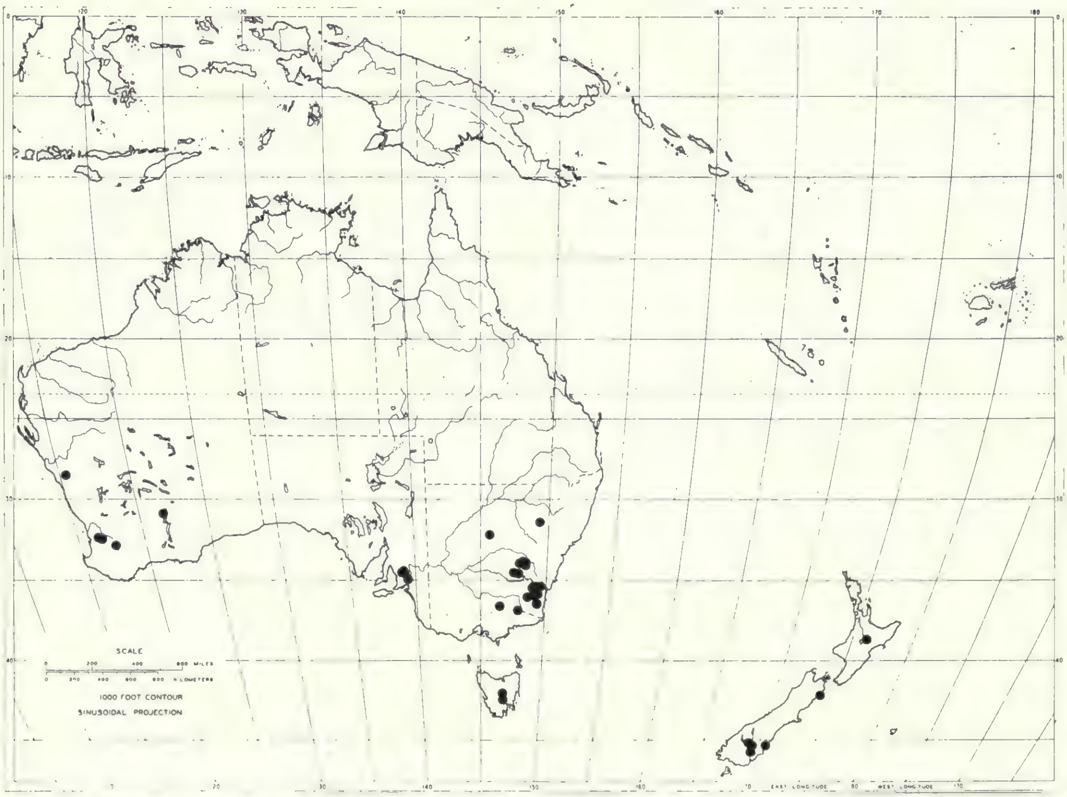
X. furcata is common but scattered in a variety of habitats throughout south-eastern Australia, but confined mainly to coastal rocks in North Island, New Zealand. It favours well-drained, exposed rock surfaces. Common associates include *Cladia aggregata* (Swartz) Nyl. and other species of *Xanthoparmelia* including *X. tasmanica, X. notata, X. glareosa, X. eradicata*, and *X. flavescentireagens*.

48. **Xanthoparmelia glareosa** (Kurok. & Filson) Elix & Jen Johnston, **comb. nov.**

Basionym: *Parmelia glareosa* Kurok. & Filson in Filson in *Aust. J. Bot.* **30**: 536 (1982). Type: Australia, New South Wales, 15 km east of Cooma on the Numeralla road, *c.*850 m, *S. Kurokawa* 6447 (TNS – holotype, MEL 1522913! – isotype).

Illustration: Filson (op. cit.).

Description. *Thallus* foliose, adnate on pebbles but commonly spreading to surrounding soil, yellow-green, becoming greyish with age, 5–10 cm diam.; *lobes* subirregular, elongate, imbricate, 1·0–3·0 mm wide, with distinct black margins; secondary lobes 0·4–1·0 mm wide, subdichotomously branched, overlying centre of thallus but sometimes becoming dominant. *Upper surface* dull or commonly shiny, emaculate, ± smooth, lacking soredia and isidia; medulla white. *Lower surface* black, with a broad, brown-black to brown zone near lobe apices, sparsely to moderately rhizinate, rhizines simple or dichotomously divided, concolorous with



Map 48 Distribution of *Xanthoparmelia glareosa* in Australia and New Zealand.

lower surface. *Apothecia* common, sessile to substipitate, 2·0–6·0 mm diam., concave; disc cinnamon-brown, margin thin, strongly involute at first but becoming crenulate and lacerate; spores 10–12 × 5–6 μm.

CHEMISTRY. Thallus K−; medulla K+ yellow becoming red, C−, KC−, P+ yellow-orange; containing usnic acid, norstictic acid (major), connorstictic acid and salazinic acid.

DISTRIBUTION. Southern Australia (NSW, ACT, Vic, Tas, SA, WA) and New Zealand. Map 48. On rocks, pebbles and spreading on to soil in upland or subalpine habitats. Specimens examined: 75.

NOTES. This species is characterised by the black lower surface of the lobes with a rather broad, dark-brown or brown zone towards the apices, rhizines that are commonly dichotomously branched, and by thalli which grow on pebbles and often spread over soils.

This species resembles *X. congesta* in chemistry; for the distinction of these taxa refer to the discussion under the latter species.

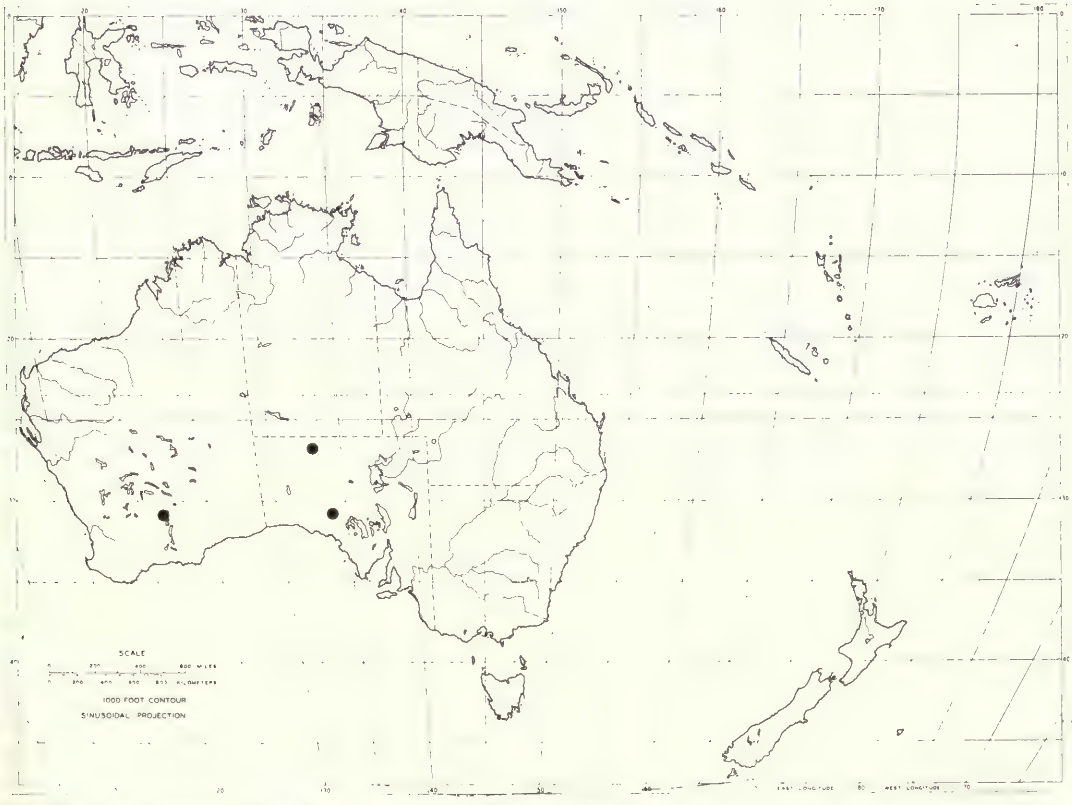
X. glareosa is a relatively common species in the ranges of southern Australia where it is usually found growing together with other species of *Xanthoparmelia* including *X. substrigosa, X. tasmanica, X. scabrosa, X. flavescentireagens,* and *X. notata*.

49. **Xanthoparmelia globulifera** (Kurok. & Filson) Hale

in *Mycotaxon* **20**: 79 (1984).

≡ *Parmelia globulifera* Kurok. & Filson in *Bull. natn. Sci. Mus. Tokyo* B, **1**: 38 (1975). Type: Australia, South Australia, Wynbring Rocks, 1·2 km north of Wynbring on transcontinental railway line, growing on granite rocks in open situation, *R. Filson* 11940 p. maj. p. (MEL! – holotype).

Illustration: Kurokawa & Filson (op. cit.).



Map 49 Distribution of *Xanthoparmelia globulifera* in Australia.

DESCRIPTION. *Thallus* foliose to subcrustose, tightly adnate, saxicolous, pale yellow, irregularly lobate, to 13 cm diam.; *lobes* not at all imbricate, ± discrete at periphery of thallus, 0·6–3·0 mm wide, older lobes irregularly cracked and becoming areolate. *Upper surface* opaque, emaculate, often with numerous tangential cracks, with numerous isidia, *isidia* often branched and apices ± inflated and erupting but barely becoming sorediate; medulla white. *Lower surface* brown, sparsely rhizinate, rhizines yellow-brown to brown, 0·1–0·3 mm long. *Apothecia* not seen.

CHEMISTRY. Thallus K−; medulla K−, C−, KC−, P−; containing usnic acid, constipatic acid, and protoconstipatic acid.

DISTRIBUTION. Rare in South Australia and Western Australia (Nullarbor – Kalgoorlie region). Map 49. On exposed rocks in arid areas. Specimens examined: 3.

NOTES. This species is characterised by an areolate or subcrustose thallus, the presence of erumpent isidia, and a pale lower surface. Three species exhibit this combination of morphological characters, viz., *X. dayiana, X. praegnans,* and *X. globulifera*; they are most readily distinguished chemically. Both *X. dayiana* and *X. praegnans* contain β-orcinol depsidones (P+ orange), but *X. globulifera* contains only the aliphatic acids, constipatic acid, and protoconstipatic acid. Morphologically *X. globulifera* has somewhat broader lobes (1–3 mm wide) than the other two species (lobes 0·5–1·5 mm wide).

X. globulifera is a very rare species found growing with other arid zone species of *Xanthoparmelia* including *X. isidiosa, X. praegnans*, and *X. cravenii*, as well as with *Acarospora schleicheri* (Ach.) Massal. and a species of *Caloplaca*.

50. **Xanthoparmelia gongylodes** Elix & Jen Johnston, **sp. nov.**

Thallus ut in *Parmelia antleriforme* sed isidiis globosis, simplicibus demum ad apicos inflatos et acidum hyposticticum et acidum hyposalazinicum continenti differt. Superficies inferior pallido-brunnea, modice rhizinata, rhizinis simplicibus, concoloribus. Thallus 210–270 μm crassus; cortex superior 35–45 μm crassus, stratum gonidiale 14–20 μm crassum, medulla 160–210 μm crassa, cortex inferior 14–30 μm crassus. Thallus K—; medulla K+ yellow – pale red, C−, P−.

Type: Australia, South Australia, Flinders Ranges, Copley–Balcanoona road, 33 km east of Copley. 30°31′S 138°43′E, on rocks, in open scrubland, 520 m, 30 October 1984, *J. A. Elix* 18008 & *L. H. Elix* (CBG! – holotype).

Illustration: Fig. 20.

DESCRIPTION. *Thallus* subcrustose to small-foliose, adnate to loosely adnate on rocks, yellow to yellow-green, irregularly lobate, 2–3 cm diam.; *lobes* imbricate or not, irregular, marginal lobes broader, flattened, 1·0–2·0(–3·0) mm wide; older central lobes irregularly fractured and contorted, areolae commonly formed *c.* 0·3–1·0 mm diam. *Upper surface* opaque, emaculate, becoming tangentially cracked, moderately to densely isidiate, *isidia* globose at first, then cylindrical, simple or ultimately extensively branched or eventually becoming knob-like, ± inflated at apices but not erupting; medulla white. *Lower surface* pale brown to brown darker at apices, sparsely to moderately rhizinate, rhizines simple, pale brown. *Apothecia* rare, sessile, 1–4 mm diam., concave at first then undulate, margin thick, entire, becoming isidiate, disc black-brown; spores 6–8 × 3·5–4·5 μm.

CHEMISTRY. Thallus K−; medulla K+ yellow then pale red, C−, P−; containing usnic acid, hypostictic acid, hyposalazinic acid, and hypoconstictic acid (±).

DISTRIBUTION. Inland WA, northern SA. Map 50. On rocks in arid shrubland areas. Specimens examined: 4.

NOTES. This distinctive species is characterised by the moderately adnate thalli, the narrow lobes with a pale lower surface, the simple or branched isidia which become inflated at the apices, and the production of hypostictic acid and hyposalazinic acid.

Morphologically this species resembles *Xanthoparmelia antleriformis* in growth habit, the pale lower surface of the thallus, and in the production of isidia. Whereas *X. antleriformis*

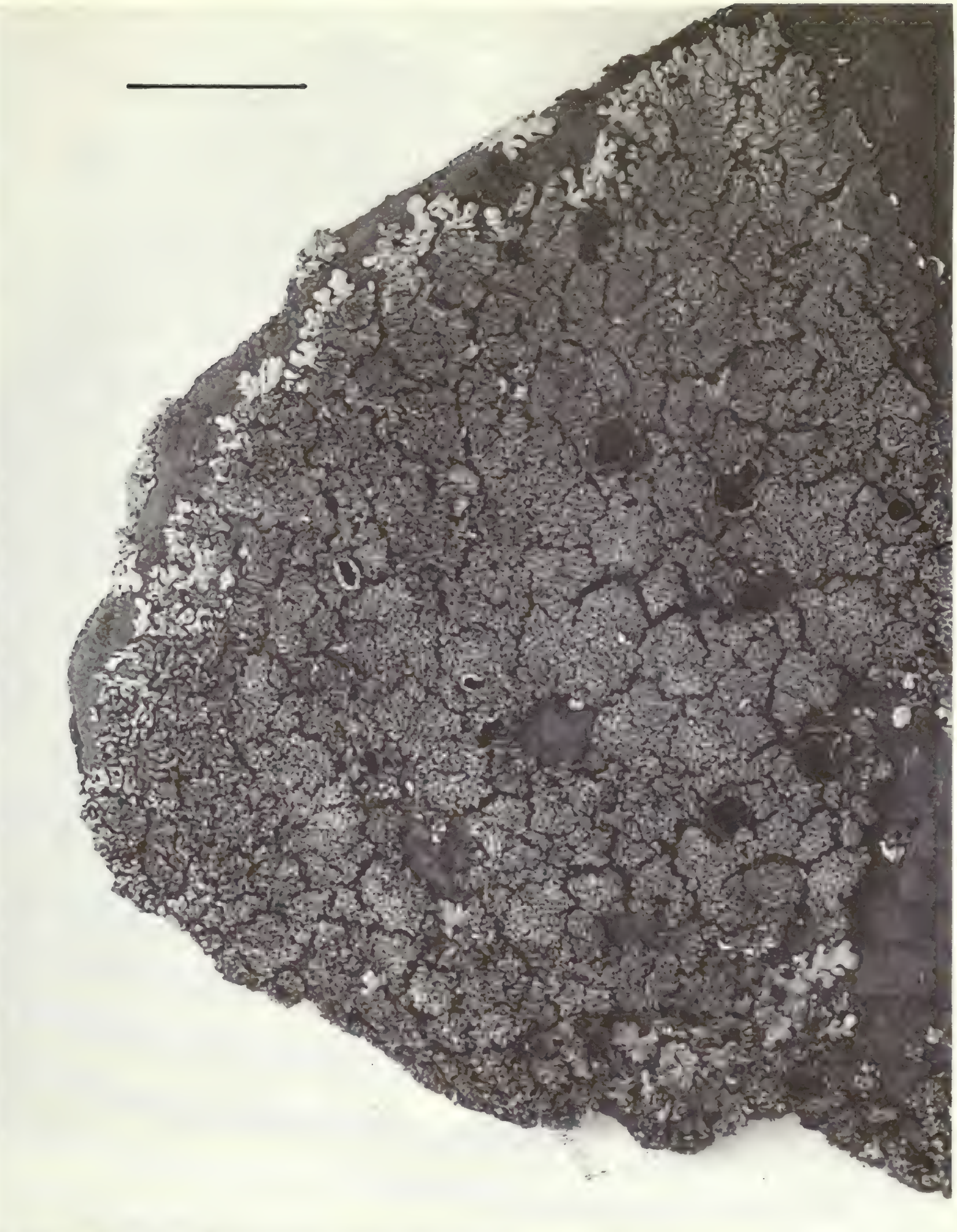
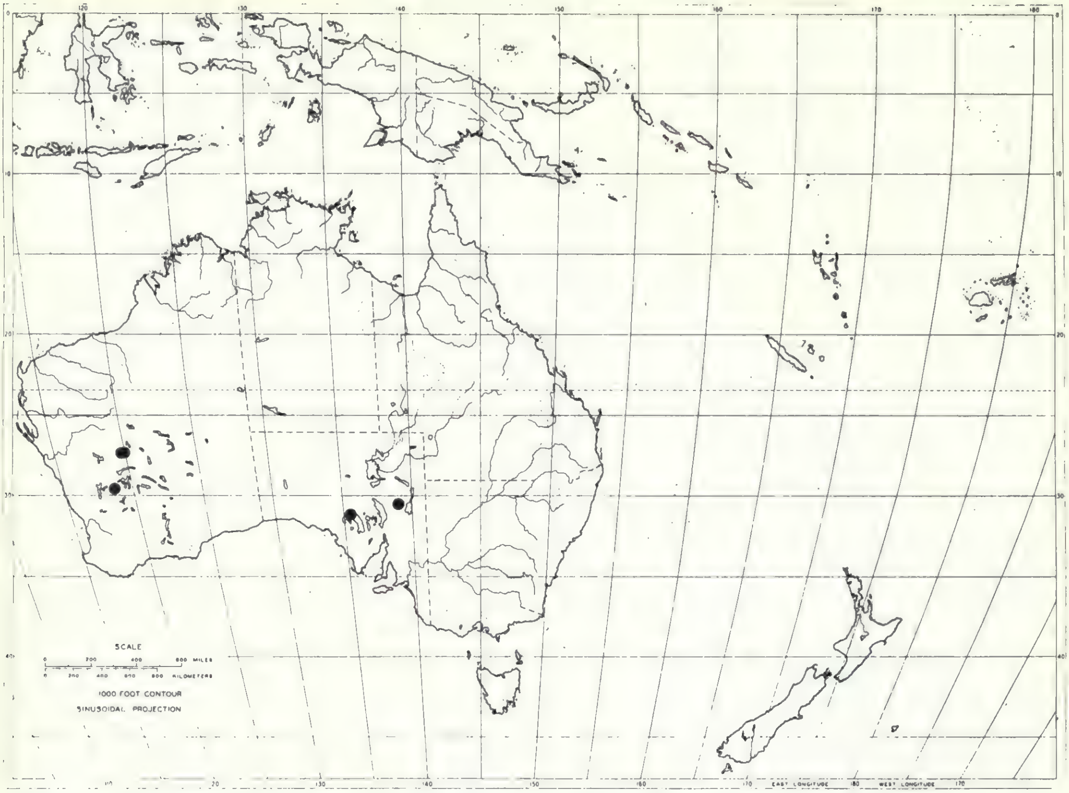


Fig. 20 *Xanthoparmelia gongylodes* Elix & Jen Johnston. Holotype in CBG. Scale = 1 cm.

produces dense cylindrical isidia which become coralloid or antleriform, *X. gongylodes* produces simple, globose isidia which become knob-like (inflated at apices) or sparingly branched.

So far *X. gongylodes* is the only isidiate Australasian *Xanthoparmelia* known to produce hypostictic and hyposalazinic acids. It could be considered the isidiate counterpart of *X. subcrustacea*, although the latter species tends to be more tightly adnate. A related South American species, *X. kalbii* Hale, exhibits a similar combination of morphological and chemical characters. *X. kalbii* differs in having a larger, foliose thallus with broader lobes (1·5–3·0 mm)



Map 50 Distribution of *Xanthoparmelia gongylodes* in Australia.

and slender erumpent isidia. *X. gongylodes* by contrast has a subcrustose to small-foliose thallus with narrow lobes (0·3–2·0 mm) and robust, globose or knob-like, inflated isidia. These two species also exhibit minor chemical differences; *X. gongylodes* contains hypostictic acid and hyposalazinic acid with (±) minor quantities of hypoconstictic acid, while *X. kalbii* contains hypostictic and hypoconstictic acids, together with (±) traces of hyposalazinic acid.

X. gongylodes is a rare species from arid inland Australia where it occurs with other aridity-tolerant lichens including *Acarospora schleicheri* (Ach.) Massal., *Xanthoparmelia isidiigera, X. cravenii, X. praegnans*, and *X. weberi*.

51. **Xanthoparmelia hypoleia** (Nyl.) Hale

in *Phytologia* **28**: 487 (1974).

≡ *Parmelia hypoleia* Nyl., *Syn. Lich.* **1**: 393 (1860). Type: South Africa, Promontorio Bonae Spei (H-NYL 34824! – lectotype).

Illustration: Fig. 21.

DESCRIPTION. *Thallus* foliose, moderately adnate on rocks, yellow-green, blackening with age, 5–8 cm diam. *Lobes* subdichotomously to irregularly branched, narrow and sublinear-elongate, imbricate or not, 0·5–1·5(–3·0) mm wide. *Upper surface* with distinct or effigurate maculae, lobes often black-margined, particularly towards apices, lacking isidia and soredia, older lobes becoming rugulose and developing tangential cracks; medulla white. *Lower surface* black, moderately rhizinate, rhizines black, simple or tufted, robust, 0·5–1·5 mm long. *Apothecia* subsessile, 3–6 mm diam., disc dark brown, exciple maculate, margin thick, entire and involute at first, becoming dentate and cracked; spores 6–8 × 4–5 μm.

CHEMISTRY. Cortex K–; medulla K+ yellow-brown, C–, P+ orange-red. Containing usnic acid, protocetraric acid, and traces of virensic acid (±).

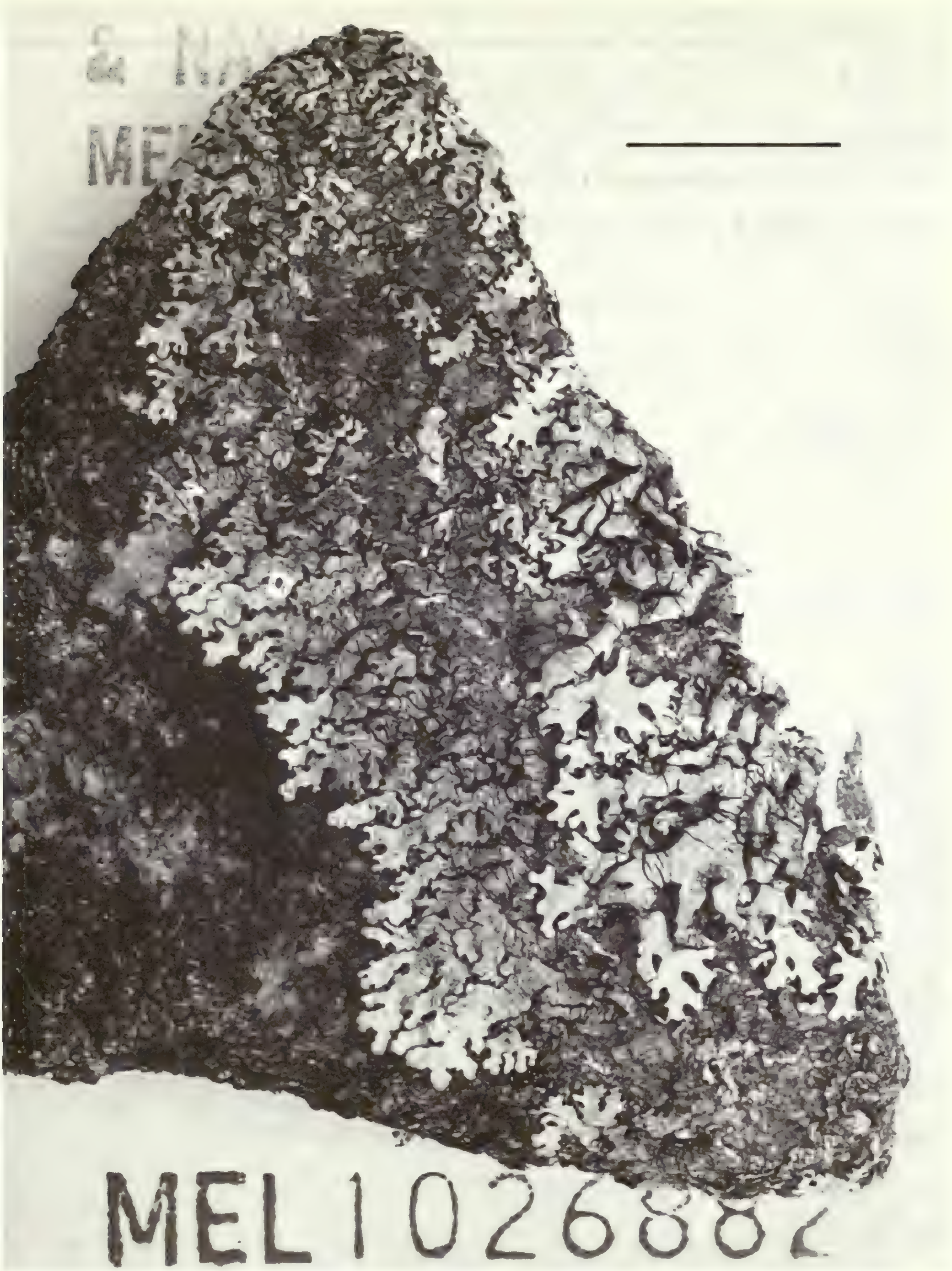
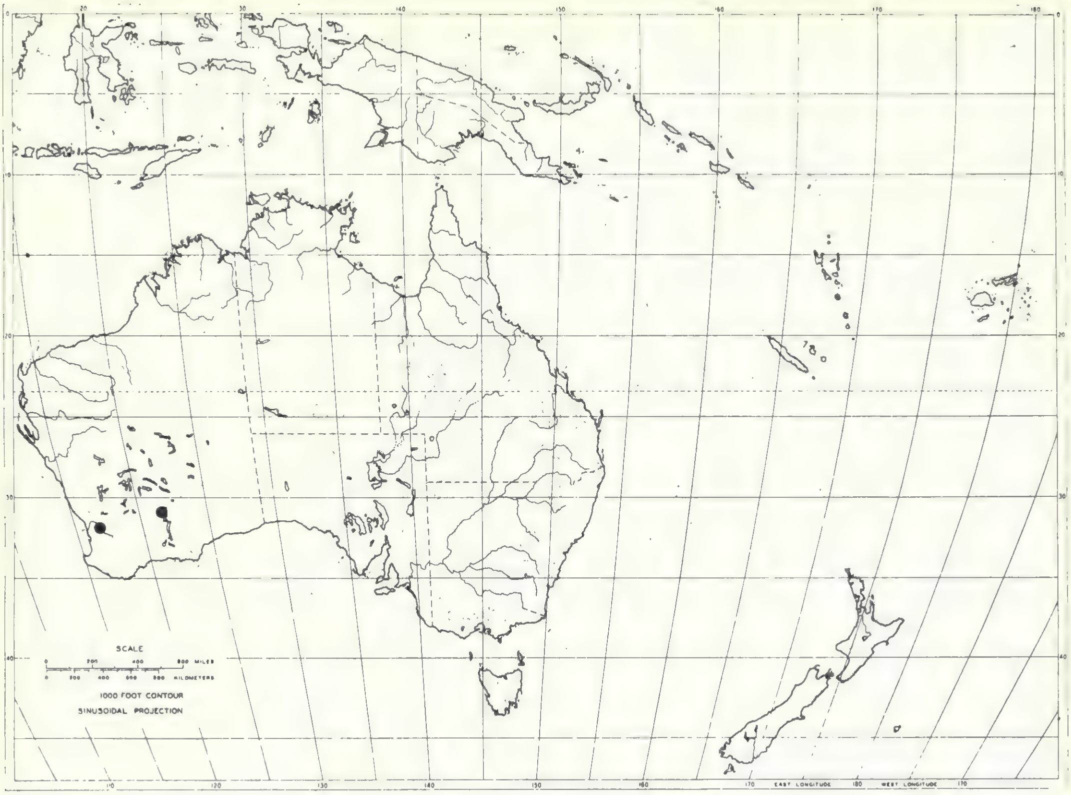


Fig. 21 *Xanthoparmelia hypoleia* (Nyl.) Hale. *Morrison* MEL 1026882. Scale = 1 cm.

DISTRIBUTION. Southwestern WA. Map 51. Also in South Africa. On rocks in coastal and temperate hinterland zones. Specimens examined: 3.

NOTES. Morphologically *X. hypoleia* resembles a group of species including *X. burmeisteri, X.*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WEST LONGITUDE
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40

Map 51 Distribution of *Xanthoparmelia hypoleia* in Australia.

hypoprotocetrarica, X. mannumensis, X. notata, and *X. pseudohypoleia*. All possess adnate to loosely adnate thalli with distinct, effigurate maculae on the upper surface, and a black lower surface. *X. hypoleia* is distinguished by the more adnate, irregular lobes but these species are more readily separated chemically as outlined in the following key.

Key to the *Xanthoparmelia hypoleia* group in Australasia

Upper cortex distinctly maculate. Lower surface black.

1a. Medulla P+ orange 2
1b. Medulla P− 4

2a(1a). Medulla K+ yellow-red (norstictic acid) .... **99. X. subnuda** (p. 330)
2b. Medulla K− or K+ brown 3

3a(2b). Thallus adnate, lobes subdichotomously to irregularly branched (protocetraric acid) **51. X. hypoleia** (p. 260)
3b. Thallus loosely adnate, lobes dichotomously branched (fumarprotocetraric acid) **85. X. pseudohypoleia** (p. 311)

4a(1b). Medulla KC+ yellow (barbatic acid – major) .... **15. X. burmeisteri** (p. 206)
4b. Medulla KC− 5

5a(4b). Lobes subascending at apices (hypoprotocetraric acid) .... **53. X. hypoprotocetrarica** (p. 265)
5b. Lobes flat, not subascending at apices 6

6a(5b). Lobes linear-elongate, di- or trichotomously divided (diffractaic acid – major) **64. X. mannumensis** (p. 283)
6b. Lobes short, irregularly or subdichotomously divided (notatic, 4-*0*-methylhypoprotocetraric acids) .... **78. X. notata** (p. 301)

To some extent these species appear to have intergrading morphologies and the only really reliable distinguishing features are the distinctive chemistries. Some of these species show quite different geographical distributions: *X. hypoleia* occurs in South Africa and Western Australia; *X. hypoprotocetrarica* in South Africa and south-eastern Australia, and *X. notata* in southern Australia and New Zealand. Where the species are sympatric and belong to the same chemosyndrome (e.g. *X. notata* and *X. hypoprotocetrarica* in south-eastern Australia), they maintain their chemical integrity even when growing side by side, so are given species status in this revision (see Elix, 1982).

X. hypoleia is a very rare species in south-western Western Australia and associates with *X. lineola, X. notata, X. tasmanica,* and *X. isidiigera*.

52. **Xanthoparmelia hypomelaenoides** Elix & Jen Johnston, **sp. nov.**

Thallus ut in *Xanthoparmelia pertinaci* sed superficie inferiore nigra differt. Thallus 150–190 μm crassus; cortex superior 15–20 μm crassus, stratum gonidiale 35–60 μm crassum; medulla 70–120 μm crassa; cortex inferior 7–10 μm crassus. Thallus K−; medulla K+ hepaticus, C−, P+ aurantiaco-rubescens.

Type: Australia, South Australia, Copley–Balcanoona road, 13 km east of Copley, Flinders Ranges, 30°32′S, 138°31′E, on rocks in open chenopod shrubland, 350 m, 30 October 1984, *J. A. Elix* 18004 & *L. H. Elix* (CBG! – holotype).

Illustration: Fig. 22.

DESCRIPTION. *Thallus* foliose, saxicolous, adnate to tightly adnate, pale yellow-green, darkening with age, irregularly lobate, to 7 cm diam.; *lobes* sublinear-elongate, imbricate or not, apices subrotund, older lobes becoming tangentially cracked, 1·0–3·0 mm wide, ± developing narrower (0·5–1·0 mm) secondary lobes. *Upper surface* shiny, at least near apices, emaculate, older

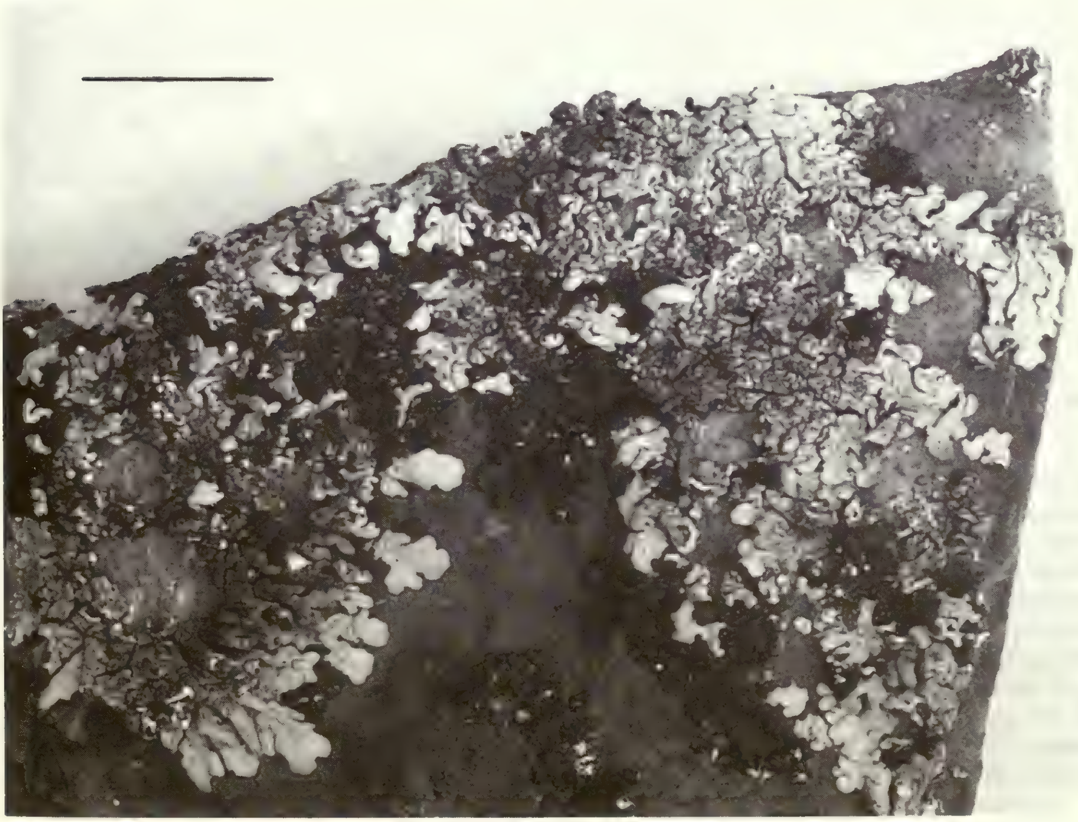
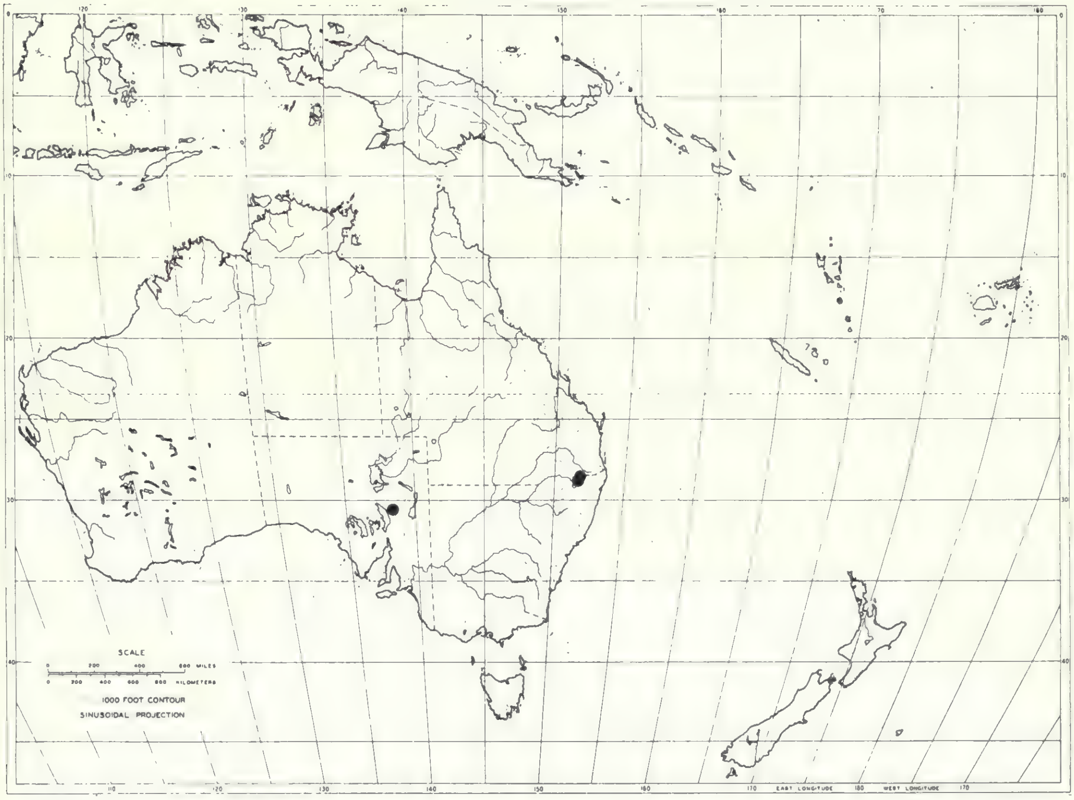


Fig. 22 *Xanthoparmelia hypomelaenoides* Elix & Jen Johnston. Holotype in CBG. Scale = 1 cm.

lobes becoming rugulose, blackening and often tangentially or irregularly cracked, often with black margins, lacking soredia and isidia; medulla white. *Lower surface* rugulose, shiny, black, moderately to sparsely rhizinate, rhizines simple or tufted, short, robust, black. *Apothecia* not seen.

CHEMISTRY. Thallus K−; medulla K+ brown, C−, KC−, P+ intense brick red; containing usnic acid, fumarprotocetraric acid, succinprotocetraric acid, and a trace of protocetraric acid.

DISTRIBUTION. Flinders Ranges, SA; south-east Qld. Map 52. Rare on rocks in subarid shrubland or hinterland ranges. Specimens examined: 4.



Map 52 Distribution of *Xanthoparmelia hypomelaenoides* in Australia.

NOTES. Morphollgically this species closely resembles *Xanthoparmelia incerta*, *X. everardensis*, and *X. elaeodes*, since these species are adnate to tightly adnate and have subrotund lobes with a black lower surface. These species are readily distinguished chemically since *X. incerta* contains salazinic acid (K+ yellow-red), *X. everardensis* diffractaic acid (K−, KC−), and *X. elaeodes* norlobaridone (KC+ rose), while *X. hypomelaenoides* contains fumarprotocetraric acid and succinprotocetraric acid (K+ brownish, P+ red). Further, lobes of *X. hypomelaenoides* tend to be significantly more linear-elongate than those of the other species.

The black lower surface and the presence of fumarprotocetraric and succinprotocetraric acid in the medulla are also characteristic of the North American species, *X. hypomelaena* (Hale) Hale. However the latter species is much more tightly adnate, with narrower lobes and diminutive thalli. We thank Dr M. E. Hale for assisting us in distinguishing these species.

X. hypomelaenoides is presently known only from the Copley area of the Flinders Ranges in South Australia and south-eastern Queensland.

53. **Xanthoparmelia hypoprotocetrarica** (Kurok. & Elix) Hale

in *Phytologia* **28**: 487 (1974).

≡ *Parmelia hypoprotocetrarica* Kurok. & Elix in *J. Jap. Bot.* **46**: 113 (1971). Type: Australia, Australian Capital Territory, Coppins Crossing, on porphyry boulders, *J. A. Elix* 101 (TNS! – holotype; MEL! – isotype; CANB! – isotype).

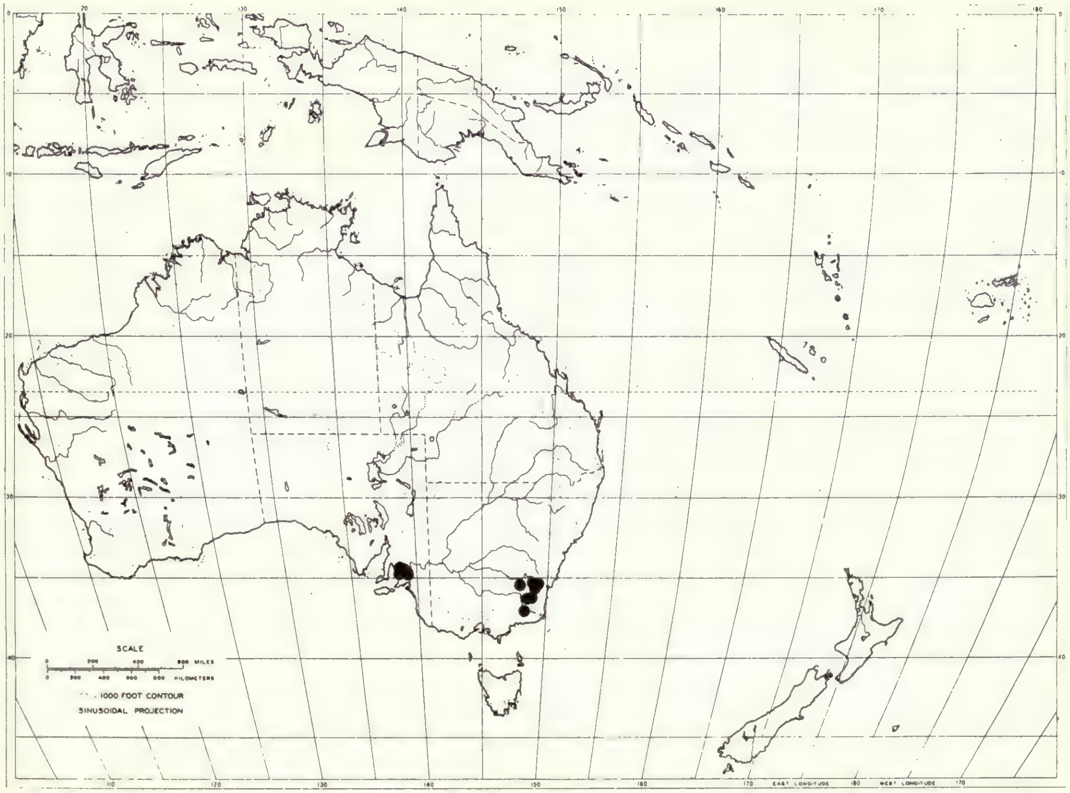
Illustration: Kurokawa & Elix (op. cit.).

DESCRIPTION. *Thallus* foliose, loosely adnate on rocks, yellow-green, subirregularly lobate, 6–8 cm diam.; *lobes* imbricate, often subascending at apices, margins crenate or not, 1·0–2·5 mm wide, secondary lobes narrower than marginal lobes, 0·5–1·0 mm wide, sublinear-elongate, subdichotomously divided, sometimes dominating thallus. *Upper surface* with distinct or effigurate maculae, often with brownish or black margins towards lobe apices; medulla white. *Lower surface* black, rugulose or not, sparsely rhizinate, rhizines black, simple, robust. *Apothecia* subsessile, 3–7 mm diam., margin distinctly undulate, disc dark brown, exciple maculate; spores 6–8 × 4–5 μm.

CHEMISTRY. Thallus K−; medulla K−, C−, KC−, P−; containing usnic acid, hypoprotocetraric acid, traces of 4-*O*-demethylnotatic acid (±).

DISTRIBUTION. Southern Australia (NSW, ACT, Vic, SA). Map 53. Also in South Africa. On rocks in subalpine zones and upland areas with moderate rainfall. Specimens examined: 31.

NOTES. This species is morphologically rather variable. The holotype has short, broad lobes with subrotund apices, while other specimens may be dominated by the sublinear, almost divaricate secondary lobes. However, the most distinctive features of *X. hypoprotocetrarica* are effigurate maculae on the upper surface, and also the black lower surface, characteristics of members of the *X. hypoleia* group. *X. hypoprotocetrarica* is distinguished from other members of this group



Map 53 Distribution of *Xanthoparmelia hypoprotocetrarica* in Australia.

by its unique chemistry, and lobes which are often subascending at the apices. A key to this group of species is given under *X. hypoleia*.

X. hypoprotocetrarica is a relatively common species in the ranges of south-eastern Australia where it prefers rocks in open habitats (e.g. pasture land). Common associates include *Cladia aggregata* (Swartz) Nyl., *Parmelia erumpens* Kurok., *Flavoparmelia haysomii* (Dodge) Hale, *Xanthoparmelia notata, X. neotinctina,* and *X. tasmanica*.

54. **Xanthoparmelia immutata** Elix & Jen Johnston, **sp. nov.**

Thallus ut in *Xanthoparmelia remanenti* sed arcte adnatus, lobis angustioribus et acidum constipaticum et acidum protoconstipaticum continenti etiam differt. Superficies superior isidiata, isidiis globosis demum cylindricibus, simplicibus demum coralloidibus. Superficies inferior pallido-brunnea, modice rhizinata, rhizinis simplicibus, concoloribus. Thallus 100–175 μm crassus; cortex superior 20–30 μm crassus, stratum gonidiale 14–35 μm crassum, medulla 35–70 μm crassa, cortex inferior 12–14 μm crassus. Thallus K−; medulla K−, C−, KC−, P−.

Type: Australia, Northern Territory, 3 km south of Barrow Creek along the Stuart Highway, on sandstone rocks in mulga scrub, 13 September 1983, *J. A. Elix* 11209 & *L. A. Craven* (CBG! – holotype).
Illustration: Fig. 23.

DESCRIPTION. *Thallus* foliose to subcrustose, tightly adnate on rocks, pale yellow-green, *c.* 3–5 cm diam.; *lobes* irregular, barely imbricate or not so, 0·2–1·0(–1·5) mm wide. *Upper surface* shiny, at least near apices, emaculate, smooth at margins, becoming tangentially or irregularly cracked, older lobes becoming rugulose and eventually areolate, isidiate, *isidia* laminal in centre of thallus, simple, globose at first then cylindrical, simple or expanding laterally and becoming branched, short coralloid; medulla white. *Lower surface* whitish to pale brown, darker at apices, shining, moderately to sparsely rhizinate, rhizines short, simple, concolorous with lower surface. *Apothecia* sessile, 0·5–1·0 mm diam., disc dark brown, concave then ± plane, margins

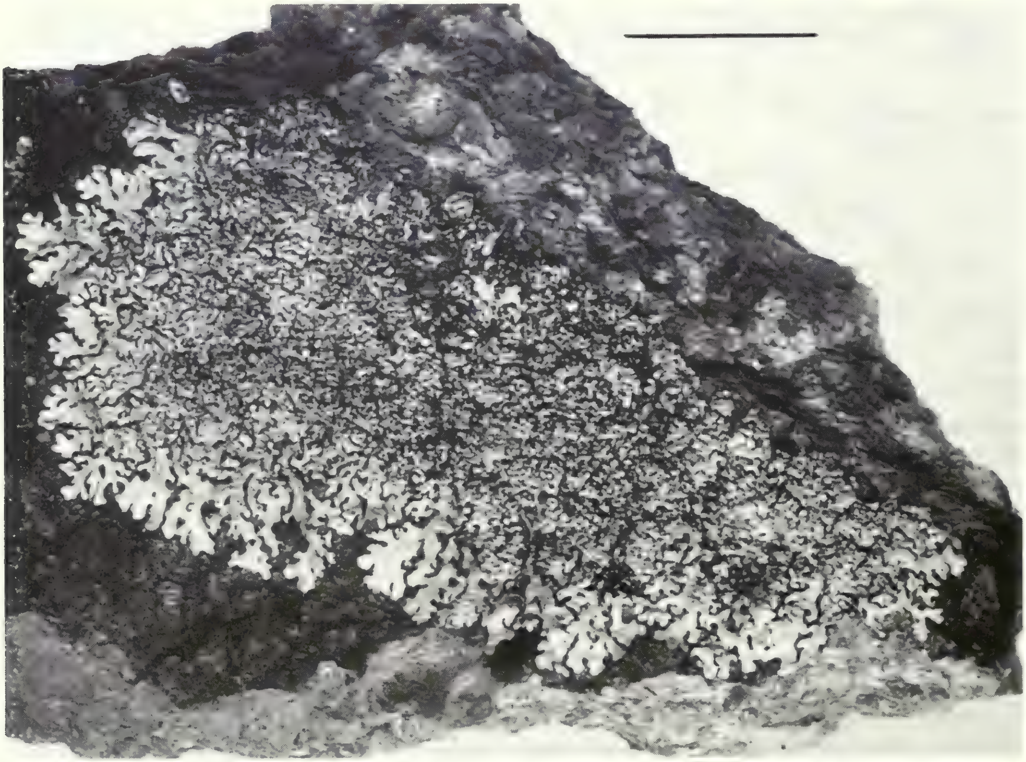
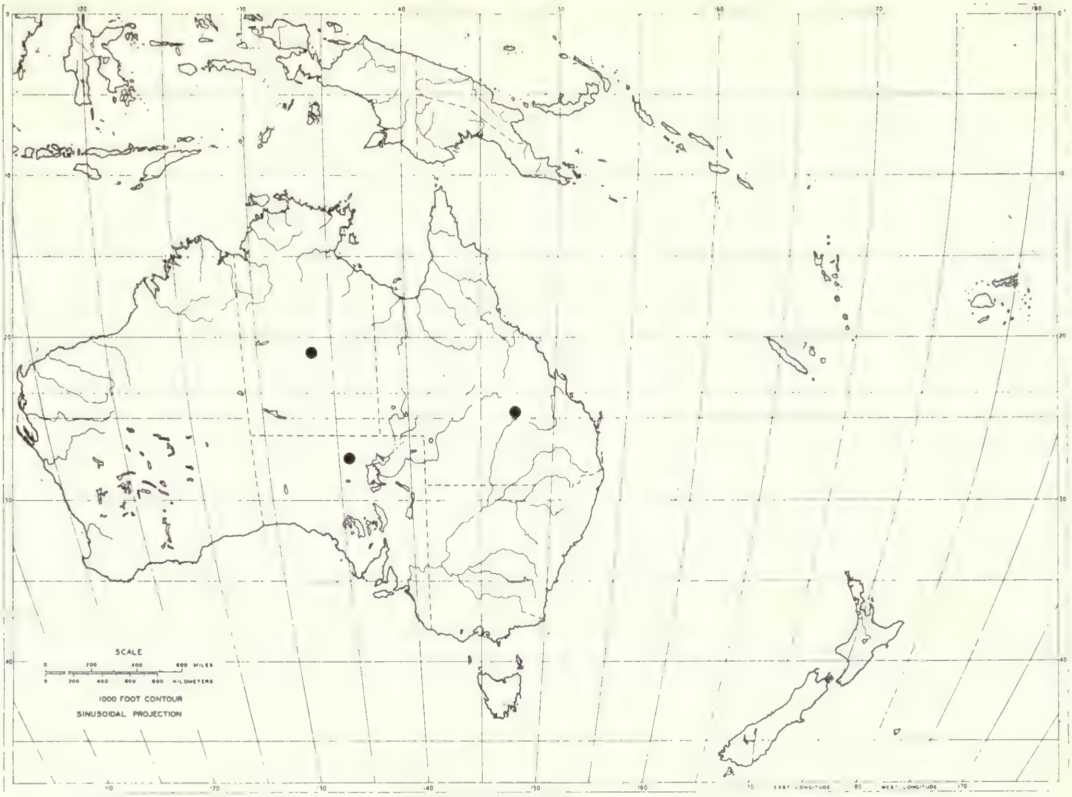


Fig. 23 *Xanthoparmelia immutata* Elix & Jen Johnston. Portion of holotype in CBG. Scale = 1 cm.



Map 54 Distribution of *Xanthoparmelia immutata* in Australia.

thick, entire, involute at first becoming thinner, exciple smooth but ultimately isidiate; spores 6–10·5 × 3·5–5·5 μm.

Chemistry. Thallus K−; medulla K−, C−, KC−, P−; containing usnic acid, constipatic acid, protoconstipatic acid, scabrosin 4-acetate-4′-hexanoate, scabrosin 4-acetate-4′-butyrate, scabrosin 4,4′-dibutyrate, scabrosin 4,4′-diacetate (±), unknown scabrosin derivatives.

Distribution. Central Australia (NT), south-western Qld and northern SA. Map 54. On rocks in arid areas. Specimens examined: 7.

Notes. In appearance this species closely resembles *Xanthoparmelia exillima* and *X. consociata* in having very narrow, tightly adnate lobes with a pale lower surface and isidia on the upper surface. Although *X. immutata* tends to have broader lobes than the other two species, and globose rather than cylindrical isidia, these taxa can be most reliably differentiated chemically since *X. consociata* contains norstictic and salazinic acid (K+ yellow-red), and *X. exillima* contains norlobaridone (K−, KC+ rose) in contrast to the negative reactions of *X. immutata*.

This new species is obviously closely related to *X. remanens* as it has a similar morphology and an overlapping chemistry Both contain scabrosin derivatives, but in addition, *X. immutata* contains the aliphatic acids, constipatic acid and protoconstipatic acid. Further, *X. remanens* has much broader (1–2 mm), moderately adnate lobes and the isidia become erumpent, while *X. immutata* has narrow (0·2–1·0 mm) tightly adnate lobes which become subcrustose at times and intact isidia. The species also differ in their geographical distribution. *X. immutata* could also be considered to be closely related to *X. globulifera*, a subcrustose species containing constipatic and protoconstipatic acids but producing open dactyls. Thus this species is readily distinguished by the vegetative propagules (i.e. open dactyls rather than globose or inflated isidia which do not burst open) and the lack of scabrosin derivatives in the medulla.

X. immutata is a rare central Australian species which occurs on rock ledges with a southerly aspect together with aridity-tolerant *X. cravenii, X. mexicana, X. subdomokosii*, and *X. weberi*.

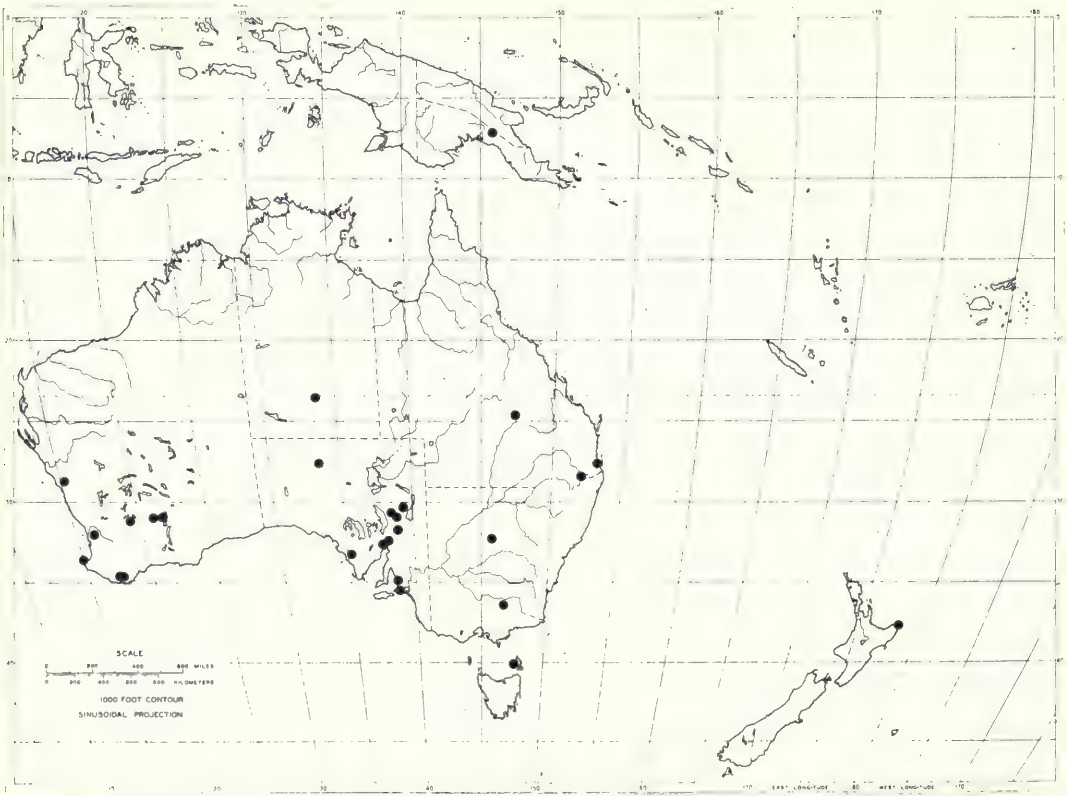
55. **Xanthoparmelia incerta** (Kurok. & Filson) Elix & Jen Johnston, **comb. nov.**

Basionym: *Parmelia incerta* Kurok. & Filson in *Bull. natn. Sci. Mus. Tokyo* B, **1**: 39 (1975). Type: Australia, South Australia, Lower Flinders Ranges, Warren Gorge, growing on rocks, *J. Curtin* 7 (MEL 34825! – holotype).

Illustration: Kurokawa & Filson (op. cit.).

DESCRIPTION. *Thallus* foliose, saxicolous, adnate to tightly adnate, pale yellow-green, darkening with age, irregularly lobate, to 5 cm diam.; *lobes* irregular , imbricate or not, apices subrotund, older lobes becoming irregularly cracked and areolate, 1·0–3·0 mm wide, ± developing narrower (0·5–1·0 mm), sublinear-elongate secondary lobes. *Upper surface* opaque, emaculate, convex, often tangentially or irregularly cracked, older lobes becoming rugulose and eventually areolate, often with black margins, lacking soredia and isidia; medulla white. *Lower surface* wrinkled, black or dark brown, paler near margins, sparsely rhizinate, rhizines simple, short, robust, black. *Apothecia* adnate, to 8 mm diam., disc dark brown, deeply concave at first but becoming flat and distorted with age, margin thin, crenulate to deeply incised; spores 11–13 × 7–8 μm.

CHEMISTRY. Thallus K−; medulla K+ yellow then red, C−, KC−, P+ intense yellow; containing usnic acid, salazinic acid, consalazinic acid, constipatic acid (±) and trace of 4-*0*-methylhypoprotocetraric acid (±).



Map 55 Distribution of *Xanthoparmelia incerta* in Australasia.

DISTRIBUTION. Australia (Qld, Vic, Tas, SA, WA, NT) and North Island, New Zealand (East Coast), Papua New Guinea. Map 55. On exposed rocks in subarid, arid, or montane tropical areas. Specimens examined: 45.

NOTES. This species may be confused with *X. lineola* because both taxa have tightly adnate lobes and produce salazinic acid. However, the lobes of *X. lineola* tend to be more linear-elongate, with a pale brown to tan lower surface with moderate, slender, pale rhizines. On the other hand the lobes of *X. incerta* are irregular and the lower surface is black to dark brown, with sparse, robust, black rhizines. The chemistry, lower surface, and rhizines of *X. incerta* are reminiscent of *X. tasmanica*, but the latter species is loosely adnate.

Morphologically *X. incerta* most closely resembles *X. everardensis, X. hypomelaenoides,* and *X. elaeodes*; *X. incerta* has somewhat broader (often 2–3 mm wide cf. 1–2 mm) lobes, larger spores, and differs chemically, as outlined under *X. elaeodes*.

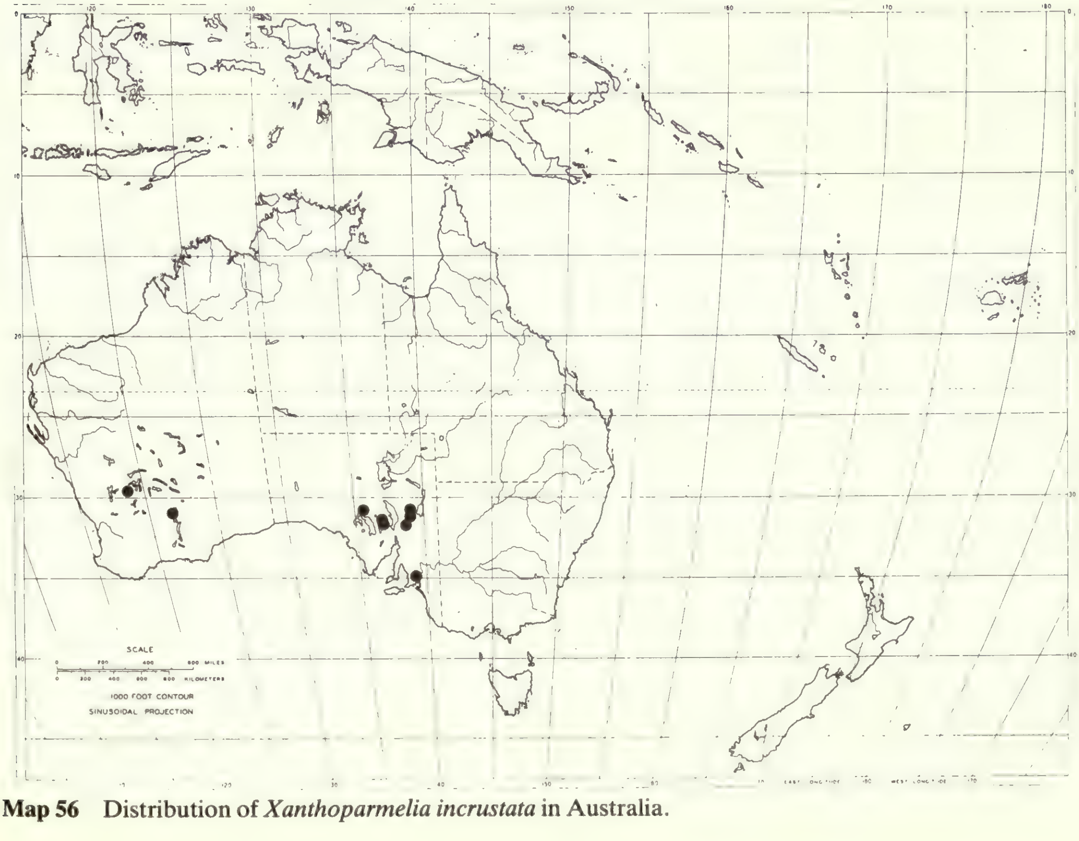
X. incerta prefers dry habitats, where it grows on exposed rocks together with *X. filarszkyana, X. lineola, X. mexicana, X. pertinax,* and *X. scabrosa*.

56. **Xanthoparmelia incrustata** (Kurok. & Filson) Elix & Jen Johnston, **comb. nov.**

Basionym: *Parmelia incrustata* Kurok. & Filson in *Bull. natn. Sci. Mus. Tokyo* B, **1**: 39 (1975). Type: Australia, South Australia, summit of Wallabyng Range, about 21 km north of Kingoonya, on quartzite pebbles, *R. Filson* 11958 (MEL 1011790! – holotype).

Illustration: Kurokawa & Filson (op. cit.).

DESCRIPTION. *Thallus* foliose, adnate, saxicolous, yellow to pale yellow-green, subirregularly lobate, 2–4 cm diam.; *lobes* imbricate or not, markedly convex or flattened, marginal and/or secondary central lobes canaliculate below, 0·7–1·2 mm wide. *Upper surface* opaque, irregularly



Map 56 Distribution of *Xanthoparmelia incrustata* in Australia.

cracked and older lobes becoming distinctly rugulose and ± areolate or verruculose, lacking soredia and isidia, often with a blackened margin at lobe apices; medulla white; *lower surface* ivory to pale brown, often darkening towards lobe apices, sparsely rhizinate, rhizines simple or tufted, brown, 0·1–0·3 mm long. *Apothecia* sessile, to 4 mm diam., disc dark brown, concave, becoming undulate, margin thick and involute at first, becoming thin, slightly crenulate, persistent, exciple smooth; spores 10–12 × 5–6 μm.

CHEMISTRY. Thallus K−; medulla K−, C−, KC+ rose, P−; thallus containing usnic acid, norlobaridone, loxodin and rarely scabrosin 4,4′-dibutyrate (±), scabrosin 4-acetate-4′-butyrate (±), scabrosin 4-acetate-4′-hexanoate (±).

DISTRIBUTION. Inland SA and WA. Map 56. On exposed rocks and pebbles in arid shrubland. Specimens examined: 28.

NOTES. This species differs from other tightly adnate species with a pale lower surface by developing convex marginal and/or secondary lobes with a canaliculate lower surface. Consequently this species seems to be related to *X. subdistorta* since they both have a convex upper surface, a pale lower surface, and produce loxodin and norlobaridone. However, *X. incrustata* is adnate on pebbles, whereas *X. subdistorta* grows directly on soil, being rather loosely adnate. Further, lobes of *X. subdistorta* are usually dichotomously branched and linear-elongate. In contrast, in *X. incrustata*, lobes are subirregularly branched and rather short. Occasionally *X. incrustata* tends to intergrade with *X. filarszkyana*, a tightly adnate species with broader lobes and rotund apices. Although chemically identical, *X. filarszkyana* always has flat lobes.

Morphologically *X. incrustata* is virtually identical with *X. examplaris* and these two species can only be reliably distinguished by chemical means – *X. examplaris* producing salazinic acid in the medulla (K+ yellow-red) rather than the loxodin and norlobaridone of *X. incrustata* (K−).

X. incrustata is a common but restricted species from inland South Australia and Western Australia where it is found on exposed rocks and pebbles growing with *X. filarszkyana, X. mexicana, X. lineola*, and *X. pertinax*.

57. **Xanthoparmelia iniquita** Elix & Jen Johnston, **sp. nov.**

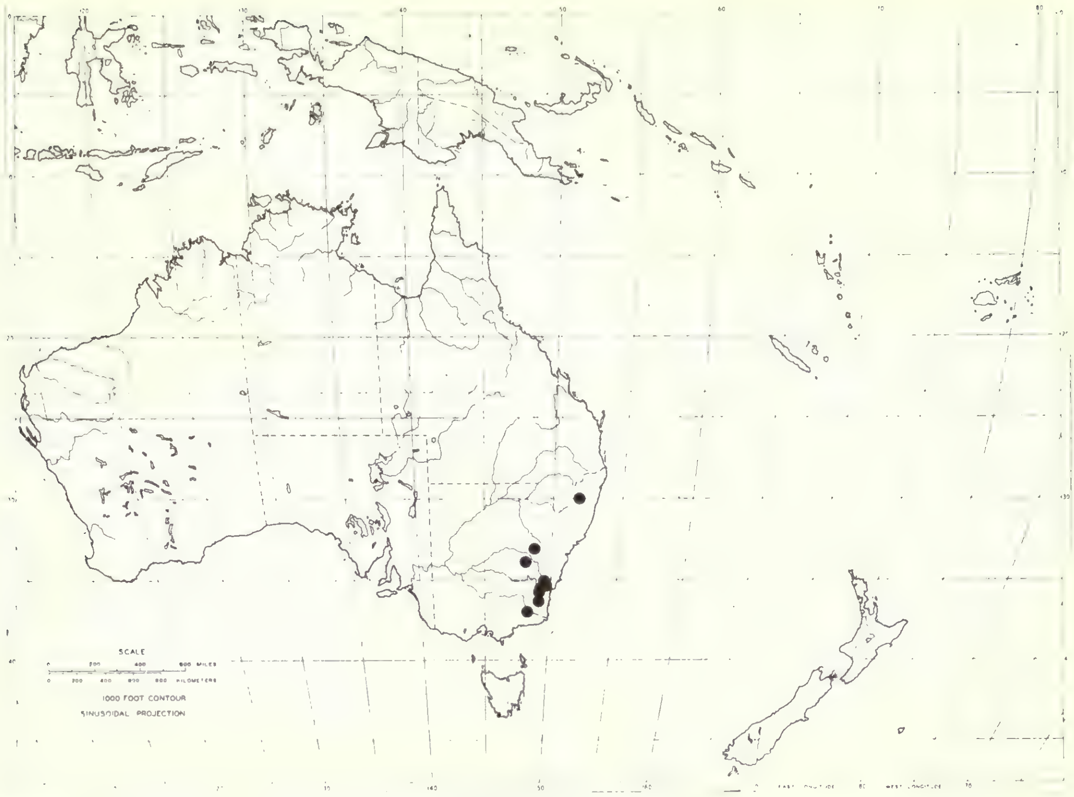
Thallus ut in *Xanthoparmelia flavescentireagenti* sed lobis latioribus et acidum fumarprotocetraricum et acidum succinprotocetraricum continenti differt. Superficies inferior pallido-brunnea, modice vel dense rhizinata, rhizinis concoloris, simplicibus vel parce ramosis. Thallus 175–350 μm crassus; cortex superior 20–28 μm crassus, stratum gonidiale 20–35 μm crassum, medulla 120–130 μm crassa, cortex inferior 14–20 μm crassus. Thallus K−; medulla K+ hepaticus, C−, P+ aurantiaco-rubescens.

Type: Australia, New South Wales, Weddin State Forest, 25 km west-south-west of Grenfell, on sandstone rocks, in *Callitris* woodland, 365 m, 14 July 1978, *J. A. Elix* 4781 (CBG! – holotype).

Illustration: Fig. 24.

DESCRIPTION. *Thallus* foliose, loosely adnate on rocks, yellow-green, darkening with age, irregularly lobate, 6–8 cm diam.; *lobes* variable, irregular to linear-elongate, moderately to sparingly imbricate, 2·0–3·0(–5·0) mm wide, apices crenulate, ± rotund, occasionally developing narrower (0·8–1·5 mm), subdichotomously divided secondary lobes. *Upper surface* slightly shiny or dull, emaculate, lacking isidia and soredia, becoming rugose and cracked with age, margins commonly blackened; medulla white. *Lower surface* pale ivory to tan, darker towards apices, moderately to densely rhizinate, rhizines concolorous with lower surface, simple or very rarely sparingly branched. *Apothecia* scattered, adnate, up to 8 mm diam.; disc concave then undulate-distorted, brown to dark brown, margin thick and involute at first, then thin, persistent; spores 8–9 × 5–5·5 μm.

CHEMISTRY. Thallus K−; medulla K+ yellow-brown, C−, P+ orange red; containing usnic acid, fumarprotocetraric acid, succinprotocetraric acid, and (±) trace of protocetraric acid.



Map 57 Distribution of *Xanthoparmelia iniquita* in Australia.

DISTRIBUTION. Eastern Australia (Qld, NSW, ACT, Vic). Map 57. On rocks in upland areas with moderate rainfall. Specimens examined: 11.

NOTES. Morphologically this species closely resembles *Xanthoparmelia flavescentireagens*, as both species are loosely adnate on rocks and have broad lobes with ± narrower secondary lobes and a pale lower surface. However, *X. iniquita* has consistently broader lobes than *X. flavescentireagens* and the lower surface is generally more densely rhizinate. In consequence *X. iniquita* is often more adnate than *X. flavescentireagens*, and these two species have quite distinctive medullary chemistries. *X. flavescentireagens* contains loxodin and norlobaridone (KC+ rose), while *X. iniquita* has fumarprotocetraric and succinprotocetraric acids (P+ red-orange).

Chemically *X. iniquita* is identical with *X. pertinax* but the latter species has subirregular, broad lobes which are tightly adnate to the substrate, becoming cracked and ± areolate centrally, and does not develop narrower, subdichotomously divided secondary lobes. However, primary lobes in *X. iniquita* and *X. pertinax* are quite comparable and differ only in the degree of adnation. Even so, these species have quite distinct geographical ranges within Australia (cf. Maps 57, 81). *X. iniquita* closely resembles the South African species *X. phaeophana* in gross morphology and chemistry. However the lower surface of *X. phaeophana* is erhizinate or very sparsely rhizinate with short, simple rhizines, while *X. iniquita* is densely to moderately rhizinate, with slender, elongated ± irregularly branched rhizines. Furthermore, *X. phaeophana* always contains traces of physodalic acid (as well as fumarprotocetraric, succinprotocetraric, and protocetraric acids), but this substance is not observed in *X. iniquita*.

X. iniquita is a rarely collected species in south-eastern Australia, where it associates with *X. flavescentireagens*, *X. hypoprotocetrarica*, *X. notata*, *X. scabrosa*, and *X. tasmanica*.

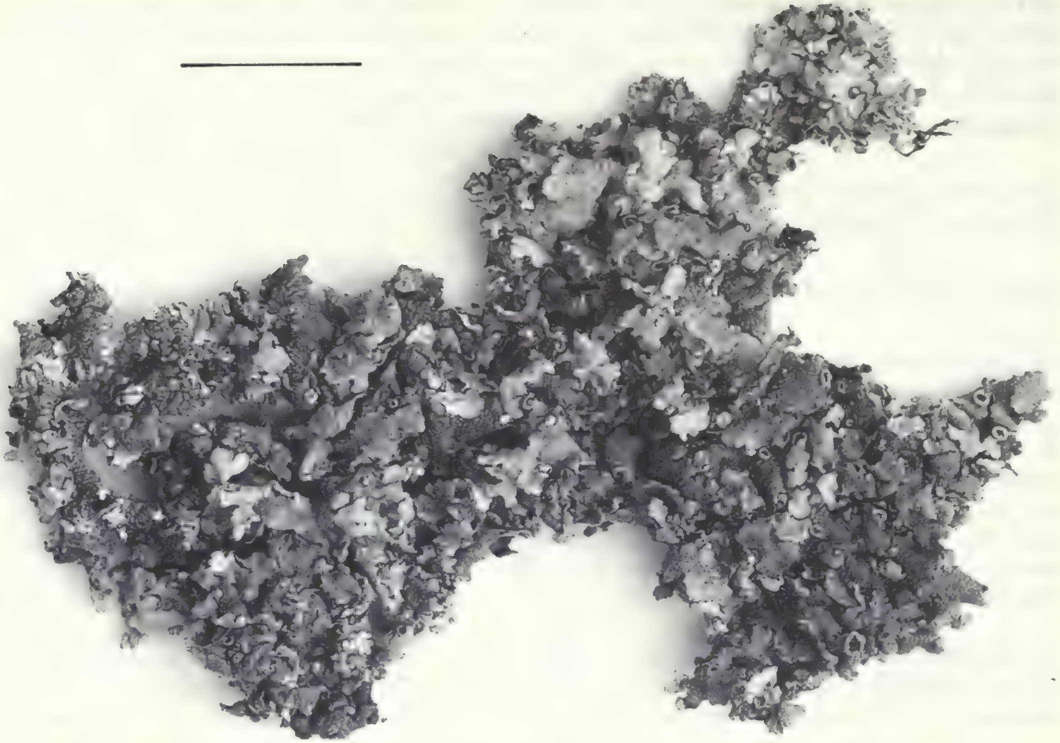


Fig. 24 *Xanthoparmelia iniquita* Elix & Jen Johnston. Portion of holotype in CBG. Scale = 1 cm.

58. **Xanthoparmelia isidiigera** (Müll. Arg.) Elix & Jen Johnston, **comb. nov.**

Basionym: *Parmelia conspersa* var. *laxa* f. *isidiigera* Müll. Arg. in *Flora, Jena* **66**: 48 (1883). Type: Australia, Western Australia, King Georges Sound, *Harris* 52 (G – lectotype, US! – isolectotype).

≡ *Parmelia isidiigera* (Müll. Arg.) Gyelnik in *Annls hist.-nat. Mus. natn. hung.* **29** (Bot.): 27 (1935), non *Parmelia isidiigera* (Müll. Arg.) Vainio in *Mém. Herb. Boissier* **5**: 6 (1900) (Art. 64.1).

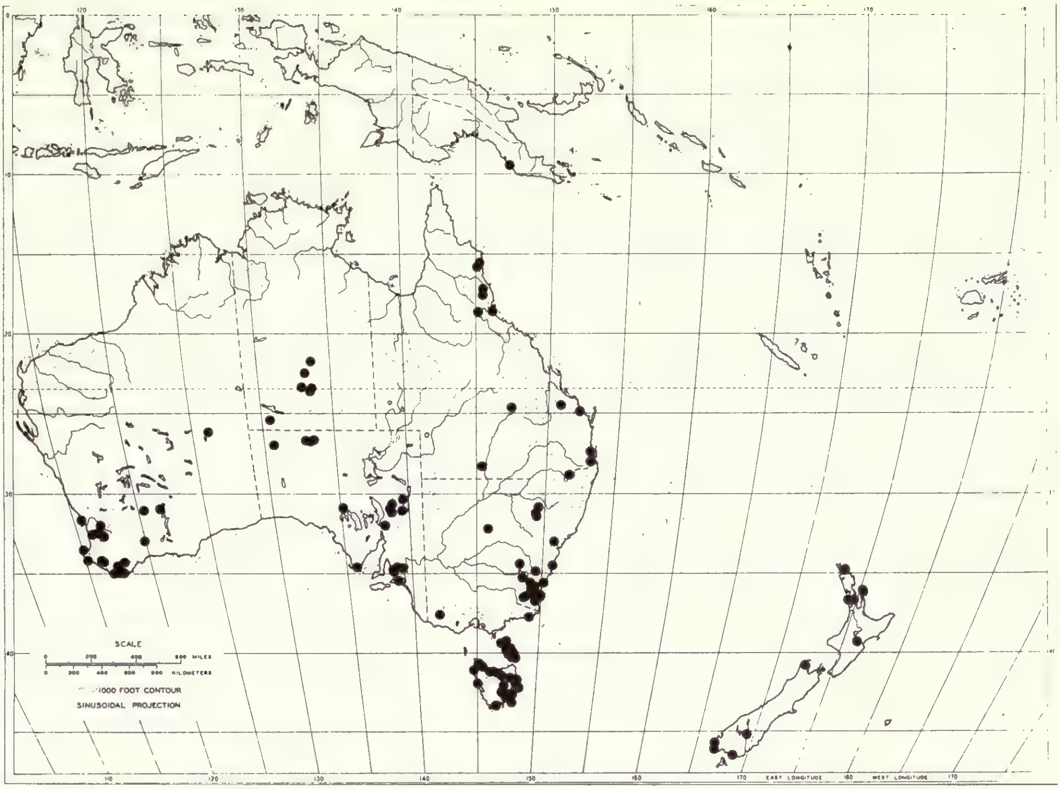
Illustration: Fig. 25.

Description. *Thallus* foliose, adnate to substrate, yellow-green, becoming blackish-green centrally, 6–10 cm diam.; *lobes* narrow, 1–2(–5) mm wide, irregular, imbricate or not, occasionally with narrower secondary lobes overlaying centre of thallus. *Upper surface* smooth, shining at least near apices, emaculate, flat to slightly convex, margins often black, entire, without soredia, isidiate, *isidia* short, commonly very slender, subglobose at first, becoming cylindrical, simple or sparingly branched; medulla white. *Lower surface* black, shining, smooth, sparsely to moderately rhizinate, rhizines short, simple, black. *Apothecia* adnate, to 6 mm diam., disc concave then undulate distorted, brown to dark brown, margin thick and involute at first, then undulate, margin and exciple isidiate; spores 7·5–8·5 × 5·0–6·5 μm.

Chemistry. Thallus K−; medulla K+ yellow becoming red, C−, KC+ red, P+ orange; containing usnic acid, salazinic acid, consalazinic acid, and ± traces of norstictic acid, protocetraric acid.

Distribution. Australia (all states and territories), Papua New Guinea and both islands of New Zealand. Map 58. Mainly on rocks in coastal habitats, rarely in mountain and subarid areas. Specimens examined: 202.

Notes. This species resembles *X. australasica* in that both species have a black lower surface, are isidiate, and contain usnic and salazinic acid. However, *X. australasica* is more loosely adnate


SCALE
MILES
KILOMETERS
1000 FOOT CONTOUR
SINUSOIDAL PROJECTION
110
120
130
140
150
160
170
EAST LONGITUDE
180
WEST LONGITUDE
170

Map 58 Distribution of *Xanthoparmelia isidiigera* in Australasia.

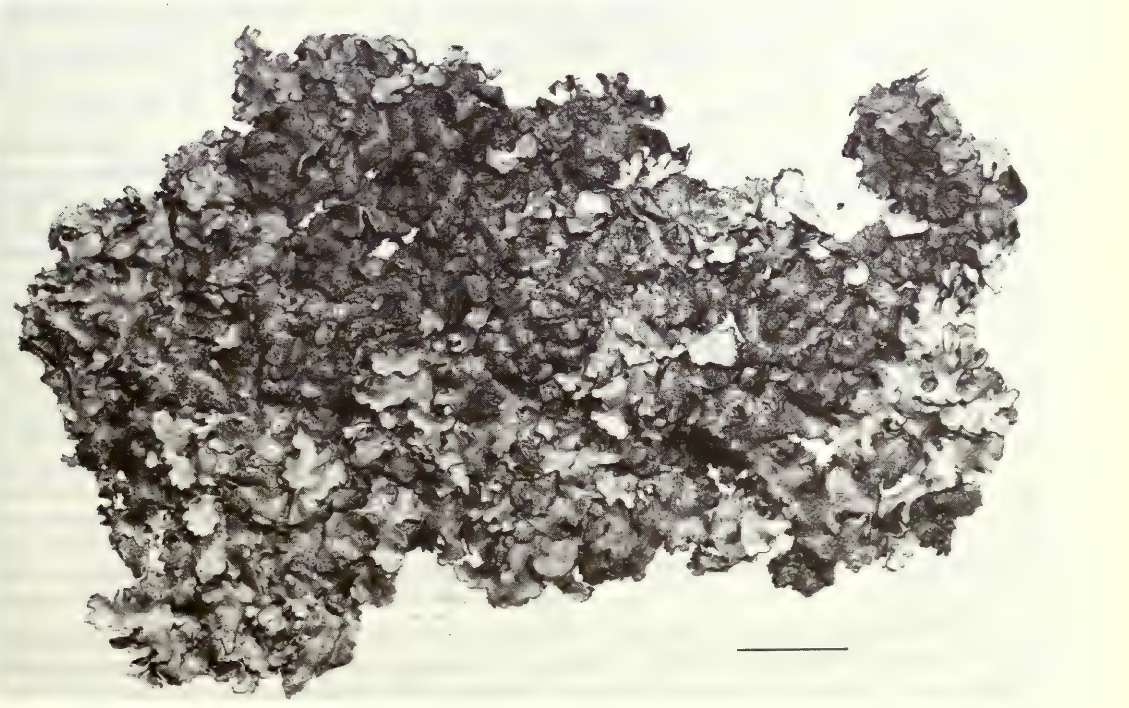


Fig. 25 *Xanthoparmelia isidiigera* (Müll. Arg.) Elix & Jen Johnston. *Elix* 10692 in ANUC. Scale = 1 cm.

than *X. isidiigera* and develops an extensive mat of robust, broad, coralloid-branched isidia centrally. By contrast, *X. isidiigera* has adnate lobes with scattered, minute, subglobose to slender cylindrical isidia. *X. neotinctina* is also rather similar, but again the isidia are cylindrical with extensive coralloid-branching and the thallus contains usnic acid, norstictic acid, and (±) traces of salazinic acid. *X. nashii*, a rare species from Western Australia, has morphological features comparable with those of *X. isidiigera* and can only be distinguished reliably by chemical means. *X. nashii* contains barbatic and diffractaic acids in the medulla, while *X. isidiigera* contains salazinic acid.

X. isidiigera is particularly common on coastal rocks where it associates with *Parmotrema reticulatum* (Taylor) M. Choisy, *Caloplaca* sp., *Xanthoparmelia neotinctina, X. scabrosa, X. tasmanica,* and *X. tegeta*.

59. Xanthoparmelia isidiosa (Müll. Arg.) Elix & Jen Johnston, comb. nov.

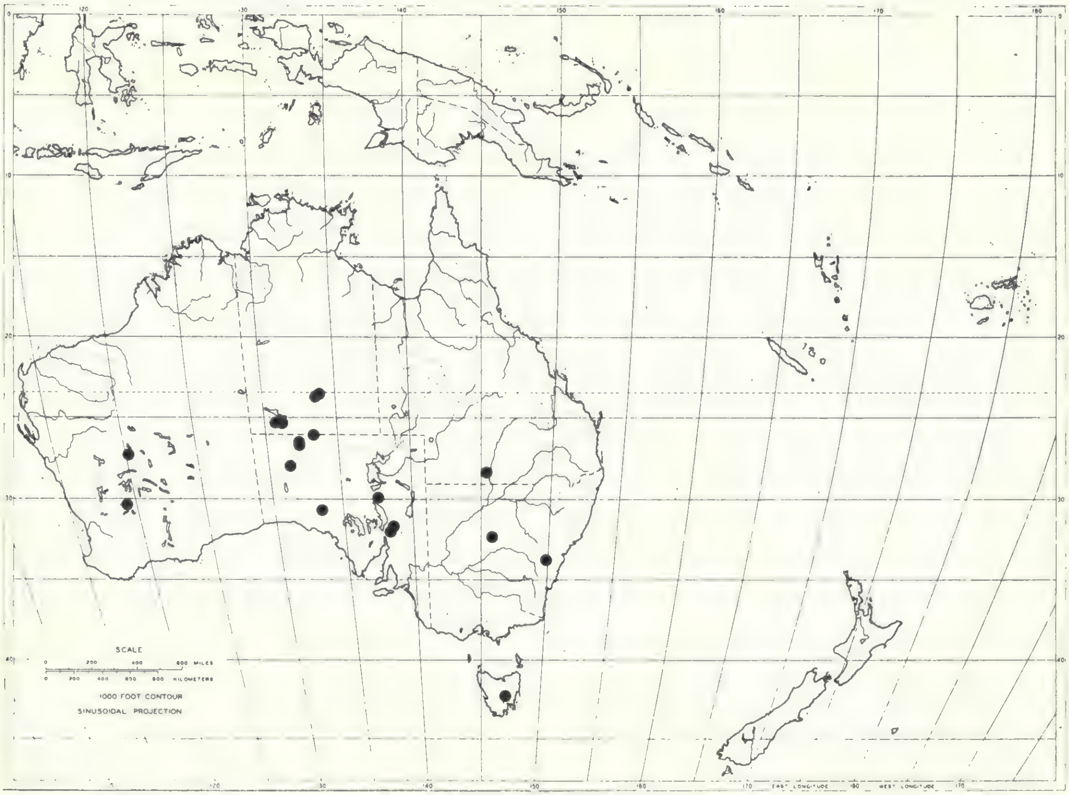
Basionym: *Parmelia conspersa* var. *stenophylla* f. *isidiosa* Müll. Arg. in *Hedwigia* **31**: 193 (1892). Type: Australia, Victoria Desert, [saxicolous], 1891, *R. Helms* 98 (G! – lectotype).

≡ *Parmelia isidiosa* (Müll. Arg.) Hale in *Bull. Torrey bot. Club* **82**: 14 (1955).

= *Parmelia refringens* Kurok. & Filson in *Bull. natn. Sci. Mus. Tokyo* B, **1**: 43 (1975). Type: Australia, South Australia, Wynbring Rocks, 1·2 km north of Wynbring on transcontinental railway line, on granite in exposed situation, *R. Filson* 11940 pr. min. p (MEL 1013381! – holotype).

Illustration: Kurokawa & Filson (op. cit.).

DESCRIPTION. *Thallus* small-foliose to subcrustose, tightly adnate, saxicolous, pale yellow to yellow-green, irregularly lobate, *c.* 4·5 cm diam., *lobes* imbricate or not, 0·7–1·5 mm wide, older lobes irregularly cracked and becoming areolate. *Upper surface* opaque, emaculate, with numerous *isidia*, isidia globose then cylindrical, commonly branched, becoming inflated at apices and rarely erupting, but not sorediose; medulla white. *Lower surface* black, sparsely



Map 59 Distribution of *Xanthoparmelia isidiosa* in Australia.

rhizinate, rhizines black, 0·3–0·8 mm long. *Apothecia* to 6·0 mm diam., disc dark brown, deeply concave; margin thick, involute, lacerate, ± isidiose; spores 7–10 × 4–6 μm.

DISTRIBUTION. Drier areas of Qld, NSW, Tas, inland SA, WA, and central Australia (NT). Map 59. On rocks in arid and subarid habitats. Specimens examined: 24.

NOTES. This species resembles *X. pustuliza* since both have narrow, adnate lobes with a black lower surface, and develop inflated dactyls or isidia which burst open at the apices. In *X. pustuliza*, however, the closed dactyls are globose and granulate, and the thallus produces usnic, norstictic, and connorstictic acids, while in *X. isidiosa* the closed dactyls are cylindrical, non-granulate, and the thallus contains usnic and salazinic acids.

Chemically and morphologically this species closely resembles *X. praegnans* and essentially the only difference is the colour of the lower surface; this is black in *X. isidiosa*, and pale brown in *X. praegnans*.

In some instances *X. isidiosa* resembles *X. isidiigera*, for initially both species have scattered globose-cylindrical isidia, a black lower cortex, and medullary salazinic acid. However isidia in *X. isidiosa* may become highly branched, are always inflated at the apices, and occasionally burst open, while those of *X. isidiigera* remain simple and intact. Moreover, lobes of *X. isidiigera* are generally broader (usually 1·5–4 mm wide cf. 0·7–1·5 mm), do not become areolate, and are less adnate than those of *X. isidiosa*.

X. isidiosa is found most commonly on rocks in central Australia where typical associates include *Acarospora schleicheri* (Ach.) Massal., *Aspicilia* sp., *Caloplaca* sp., *Xanthoparmelia cravenii, X. centralis, X. mexicana, X. scabrosa,* and *X. weberi*.

60. **Xanthoparmelia laxencrustans** Elix & Jen Johnston, **sp. nov.**

Thallus ut in *Xanthoparmelia encrustans* sed lobis laxiore adnatis et areolatis differt. Superficies inferior pallido-brunnea vel brunnea, modice rhizinata, rhizinis brunneis simplicibus. Thallus 175–210 μm crassus; cortex superior 16–20 μm crassus, stratum gonidiale 20–40 μm crassum, medulla 100–140 μm crassa, cortex inferior 10–14 μm crassus. Thallus K−; medulla K−, C−, KC−, P−; acidum usnicum et acidum hypoprotocetraricum continens.

Type: Australia, South Australia, Everard Ranges, 3 June 1891, *Helms* 86 (G! – holotype; MEL 6181! – isotype).

Illustration: Fig. 26.

Type material

In the type description of *Parmelia conspersa* var. *stenophylloides* Müll. Arg., Müller cited three specimens from the Everard Ranges in the far north of South Australia. All three specimens were collected by Richard Helms, and have thalli with narrow lobes and a pale undersurface. Gyelnik (1935) believed that the specimen from Depot No. 1 differed from the other two, but in our opinion the three specimens belong to three distinct taxa.

The syntype specimen (*Helms* 95) was chosen by Gyelnik as lectotype of *Parmelia subcrustacea* Gyelnik. The thallus becomes areolate and almost subcrustose in part, with contiguous, elongated lobes (0·5–1·5 mm wide) and produces usnic acid, hypostictic acid, and hyposalazinic acid.

The second syntype specimen cited by Müller (*Helms* 86, 3 June 1891) has shorter, somewhat narrower (0·5–0·8 mm) lobes with a convex upper surface. It also differs from the previous collection in that the areolae are separate rather than contiguous, and the thallus contains usnic acid and hypoprotocetraric acid. This taxon is considered distinct from *Parmelia subcrustacea* and is designated here as the type of *X. laxencrustans*.

The third syntype specimen of *X. conspersa* var. *stenophylloides* was collected at Depot No. 1, 16 June 1891, by Helms (but bears no collection number) and has slightly broader (1–2 mm), less appressed lobes than the other two syntypes. The thallus contains usnic acid, norstictic acid, and salazinic acid, and this specimen is synonymous with *X. metaclystoides* (q.v.).

DESCRIPTION. *Thallus* small-foliose to subcrustose in the centre, tightly adnate to rocks, pale yellow-green, 3–6 cm diam.; *lobes* irregular, congested, short, 0·5–0·8(–1·0) mm wide. *Upper surface* opaque, emaculate, plane or becoming convex in places, lacking soredia and isidia but with occasional pycnidia, often with black margins towards apices, becoming cracked and

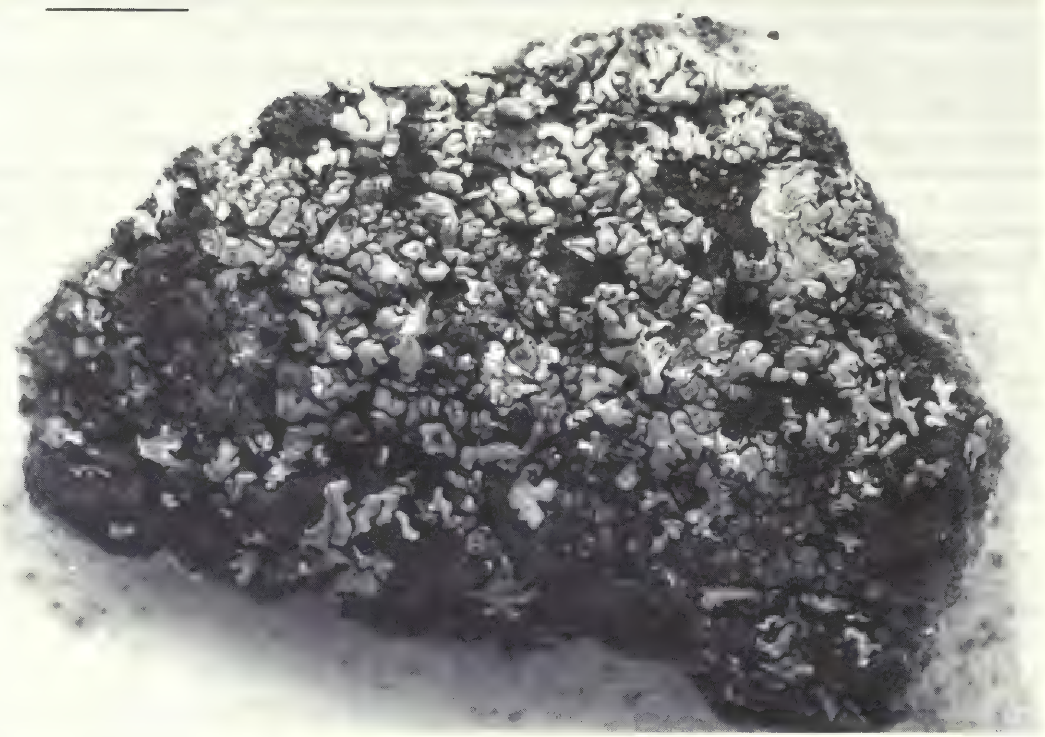


Fig. 26 *Xanthoparmelia laxencrustans* Elix & Jen Johnston. Holotype in G. Scale = 0·5 cm.

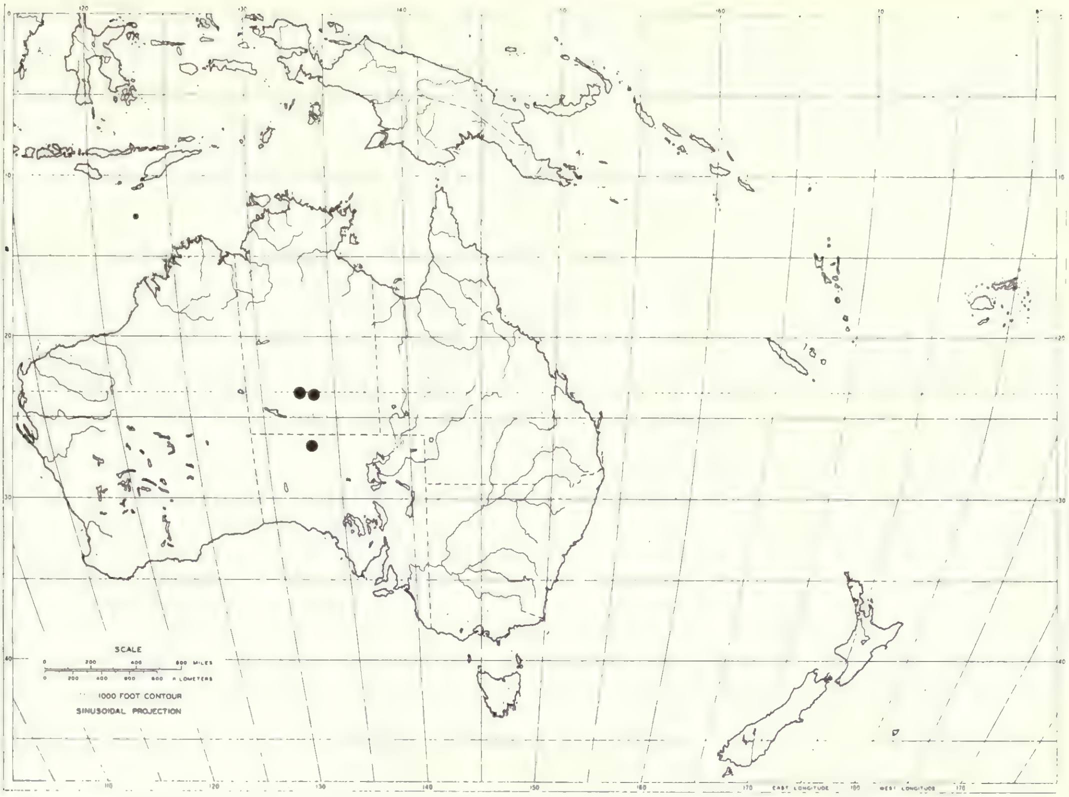
areolate in older parts of thallus; medulla white. *Lower surface* pale brown to brown, somewhat darker towards apices, moderately rhizinate, rhizines simple *c.* 0·4 mm long, concolorous with lower surface. *Apothecia* adnate, *c.* 0·3 mm wide, concave, disc dark brown, margin entire; spores 7–9 × 4·5–5·5 μm.

CHEMISTRY. Thallus K−; medulla K−, C−, KC−, P−; containing usnic acid, hypoprotocetraric acid, and a trace 4-*0*-demethylnotatic acid (±).

DISTRIBUTION. Central Australia (SA, NT). Map 60. On rocks in arid areas. Specimens examined: 4.

NOTES. This species is characterised by the tightly adnate thallus which becomes subcrustose in part, the pale lower surface, and the presence of usnic and hypoprotocetraric acids. Morphologically it resembles *X. subcrustacea* but the latter species has broader lobes (usually 0·8–1·5 mm wide cf. 0·5–0·8 mm) and contains usnic acid, hypostictic acid, and hyposalazinic acid. Other species of similar morphology include *X. dubitata, X. neorimalis, X. oleosa,* and *X. cravenii*, but the latter three differ in having linear-elongate lobes rather than the short, irregular lobes of *X. laxencrustans*. These species also differ chemically since *X. neorimalis* contains salazinic acid, *X. oleosa* constipatic acid and related fatty acids, *X. dubitata* norlobaridone, and *X. cravenii* scabrosin derivatives. Morphologically *X. dubitata* differs in having crowded, contiguous lobes. A key to this group of species is given under *X. dubitata*.

Chemically *X. laxencrustans* is identical with the subcrustose South African species, *X. encrustans* (Hale) Hale. However these two taxa show distinct morphological differences. By comparison the Australian species is more loosely adnate, while *X. encrustans* is typically placodioid (like a species of *Lecanora*) and more or less crutose with the lower cortex being attached directly to the substrate. Furthermore, the upper surface of *X. encrustans* is often pruinose towards the lobe apices. Neither of these features were observed in the Australian



Map 60 Distribution of *Xanthoparmelia laxencrustans* in Australia.

taxon. The upper cortex of *X. laxencrustans* is significantly thicker than that of *X. encrustans* (16–20 μm thick cf. 10–12 μm), while the gonidial layer is much thinner (20–40 μm cf. 50–90 μm).

X. laxencrustans is a rare central Australian species found on sheltered rock ledges with a southerly aspect. Associated species include *Acarospora schleicheri* (Ach.) Massal., *Xanthoparmelia cravenii, X. mexicana,* and *X. weberi*.

61. **Xanthoparmelia lineola** (Berry) Hale

in *Phytologia* **28**: 488 (1974).

≡ *Parmelia lineola* Berry in *Ann. Mo. bot. Gdn* **28**: 77 (1941). Type: USA, Arizona, Apache Co, 5 km north-west of Ft Defiance, open woods, on rock, 12 June 1938, *Hubricht* B1170 (US! – holotype).

= *Parmelia rimalis* Kurok. in *Bull. natn. Sci. Mus. Tokyo* B, **1**: 43 (1975). Type: Australia, South Australia, 6·4 km north of Kingoonya-Tarcoola road, 109 km west of Kingoonya, Wilgena Hill, rocky hillside, on quartzite, *R. Filson* 11923 (MEL 1011851! – holotype).

Illustration: Kurokawa & Filson (op. cit.) (as *P. rimalis*).

DESCRIPTION. *Thallus* foliose, adnate to tightly adnate, saxicolous, pale yellow to yellow-green, darkening with age, subirregularly lobate, 5–10(–15) cm diam.; *lobes* sublinear-elongate, barely imbricate or not so, at apices ± rotund, older lobes sometimes becoming irregularly cracked and areolate, 1·0–2·5 mm wide. *Upper surface* opaque, emaculate, often tangentially or irregularly cracked, older lobes becoming rugulose and eventually areolate, often with a black margin, lacking soredia and isidia; medulla white. *Lower surface* pale brown to brown, often darker towards apices, moderately to sparsely rhizinate, rhizines concolorous with lower surface, simple, slender, 0·2–0·3 mm long. *Apothecia* adnate, 1·0–5·0(–8·0) mm diam., margin thick, inrolled at first, becoming thin and slightly lacerate, disc dark brown, concave then undulate, epruinose, exciple smooth; spores 12–13 × 6–7 μm.

CHEMISTRY. Thallus K−; medulla K+ yellow then red, C−, KC−, P+ intense yellow; containing usnic acid, salazinic acid, consalazinic acid, constipatic acid (±), protoconstipatic acid (±).

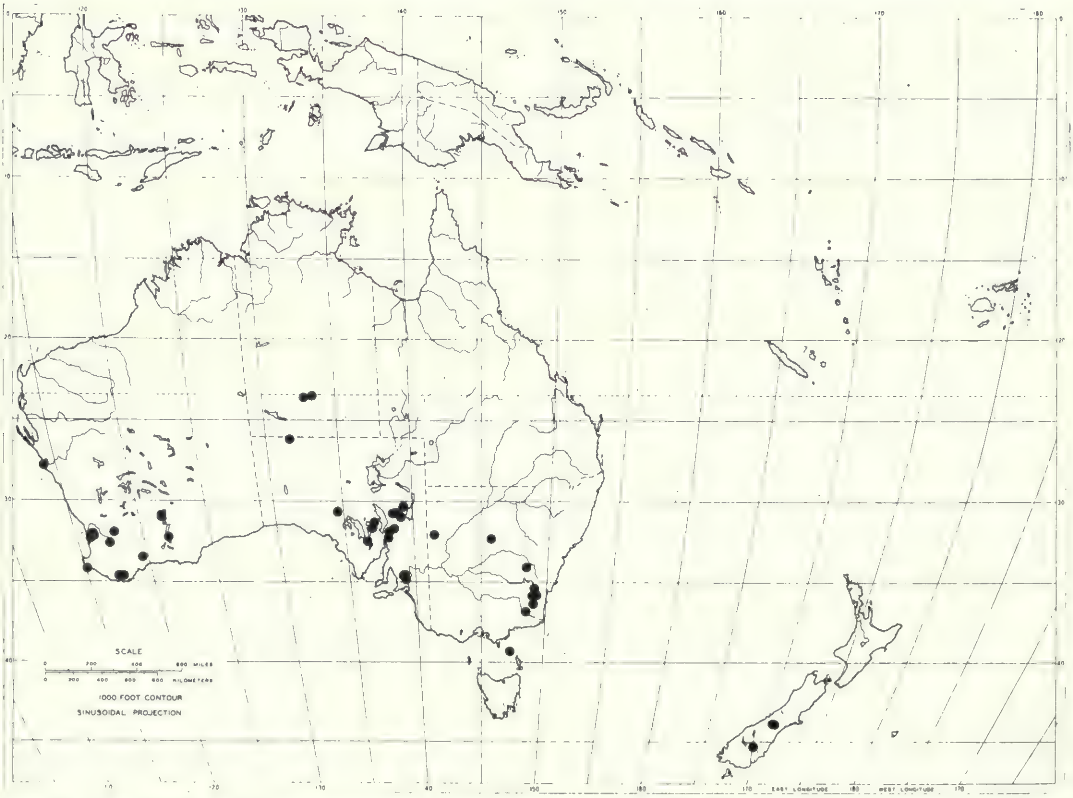
DISTRIBUTION. Southern and central Australia (NSW, ACT, SA, WA, NT), and South Island, New Zealand (Otago, Canterbury). Map 61. Also in North America (USA, Mexico). On rocks in drier upland, subarid, and arid areas. Specimens examined: 84.

NOTES. This species is characterised by the tightly adnate thallus, the broad, rotund, marginal lobes, the pale lower surface, and by the upper surface of older lobes often developing tangential cracks. This combination of characters is typical of a group of species (the so-called *X. lineola* group) including *X. barbatica, X. cravenii, X. filarszkyana, X. metaclystoides, X. pertinax, X. tucsonensis, X. subdomokosii*, and *X. verruciformis*. These species are distinguished as outlined in the key below.

X. lineola might also be confused with *X. digitiformis*, since both species have a pale lower surface and produce salazinic acid. However, *X. digitiformis* is more loosely adnate, older lobes do not become areolate, and the lobes are highly imbricate and subdigitately divided.

Most of the American specimens of this species have broader (2–5 mm wide), thicker, convex lobes which do not become areolate centrally. Even so, some specimens from arid areas of North America appear morphologically equivalent to Australian specimens. *X. lineola* may contain accessory constipatic acid and protoconstipatic acid, and, in this respect, as well as in the production of salazinic acid and in the growth habit, it closely resembles *X. incerta*. However, the latter species has a dark-brown to black lower surface with sparse, robust rhizines.

Morphologically *X. lineola* also resembles *X. ferruma*, another tightly adnate species with a



Map 61 Distribution of *Xanthoparmelia lineola* in Australia and New Zealand.

pale lower surface, which produces salazinic acid. *X. ferruma* however, is distinguished by the yellow-orange lower medulla (which contains the pigment skyrin) and by the more or less irregular marginal lobes. The marginal lobes of *X. lineola* are, invariably, linear- or sublinear-elongate.

X. lineola is a very common species in Australia, scattered on rocks from dry sclerophyll forests of southern Australia to arid grasslands and ranges of central Australia. Common associated species include *Caloplaca fulgens* (Koerb., *Acarospora schleicheri* (Ach.) Massal., *Xanthoparmelia mexicana, X. filarszkyana, X. pertinax,* and *X. scabrosa*.

Key to the *Xanthoparmelia lineola* group in Australasia

Thallus tightly adnate, marginal lobes broad, rotund, upper surface of older lobes tangentially cracked, lacking soredia and isidia; lower surface pale brown.

1a.	Marginal lobes linear or sublinear-elongate	2
1b.	Marginal lobes irregular	6
2a(1a).	Thallus with loosely adnate secondary lobes	3
2b.	Thallus lacking loosely adnate secondary lobes	4
3a(2a).	Medulla KC+ yellow (barbatic acid)	**11. X. barbatica** (p. 200)
3b.	Medulla KC− (constipatic, protoconstipatic acids)	**109. X. ustulata** (p. 344)
4a(2b).	Lobes linear elongate, medulla K+ yellow-red (salazinic acid)	**61. X. lineola** (p. 277)
4b.	Lobes sublinear-elongate, medulla K−	5
5a(4b).	Medulla containing hypoprotocetraric acid	**97. X. subdomokosii** (p. 328)
5b.	Medulla containing protoconstipatic (±), constipatic (±) acids and scabrosin derivatives	**26. X. cravenii** (p. 223)
6a(1b).	Lower medulla yellow-orange (skyrin, salazinic acid)	**42. X. ferruma** (p. 247)
6b.	Lower medulla not pigmented	7
7a(6b).	Medulla K+ yellow-red	8
7b.	Medulla K− or K+ brownish	9
8a(7a).	Lobes broad (2–4 mm), medulla K+ yellow-blood red (norstictic acid, salazinic acid)	**65. X. metaclystoides** (p. 284)
8b.	Lobes narrower (1–2 mm), medulla K+ yellow-pale red (hypostictic, hyposalazinic acid)	**95. X. subcrustacea** (p. 325)
9a(7b).	Thallus olive-yellow, medulla P+ red-orange	10
9b.	Thallus yellow-green, medulla P−	11
10a(9a).	Medulla containing fumarprotocetraric, succinprotocetraric acids	**81. X. pertinax** (p. 306)
10b.	Medulla containing protocetraric acid	**111. X. verruciformis** (p. 348)
11a(9b).	Medulla KC+ rose (norlobaridone)	**43. X. filarszkyana** (p. 249)
11b.	Medulla KC− (diffractaic acid)	**108. X. tucsonensis** (p. 343)

62. Xanthoparmelia louisii Elix & Jen Johnston, sp. nov.

Thallus ut in *Xanthoparmelia mougeotina* sed superne exisidiatus et acidum barbaticum et acidum squamaticum et acidum 4-*O*-demethylbarbaticum continenti etiam differt. Thallus arcte adpressus, versus centrum hujus fere subcrustosus; superficies inferior nigrescens. Thallus 90–140 μm crassus; cortex superior 10–14 μm crassus, stratum gonidiale 7–20 μm crassum, medulla 40–95 μm crassa, cortex inferior 7–10 μm crassus. Thallus K−; medulla K−, C−, KC+ lutescens, P−.

Type: Australia, Western Australia, Stirling Ranges, slopes of Bluff Knoll, on rocks in mixed eucalypt forest, 500 m, 25 October 1982, *J. A. Elix* 10661 & *L. H. Elix* (CBG! – holotype).
Illustration: Fig. 27.

DESCRIPTION. *Thallus* small-foliose to subcrustose, very tightly adnate to rocks, yellow-green to yellow, darkening to deep olive-brown or blackish in older lobes, 2–4 cm diam.; *lobes* contiguous or stellate, narrow, 0·2–0·8(–1·0) mm wide, not at all imbricate, becoming cracked and often forming areolae 0·2–0·5 mm diam. centrally. *Upper surface* opaque, emaculate, lacking soredia and isidia but developing tangential cracks in older lobes; medulla white. *Lower*

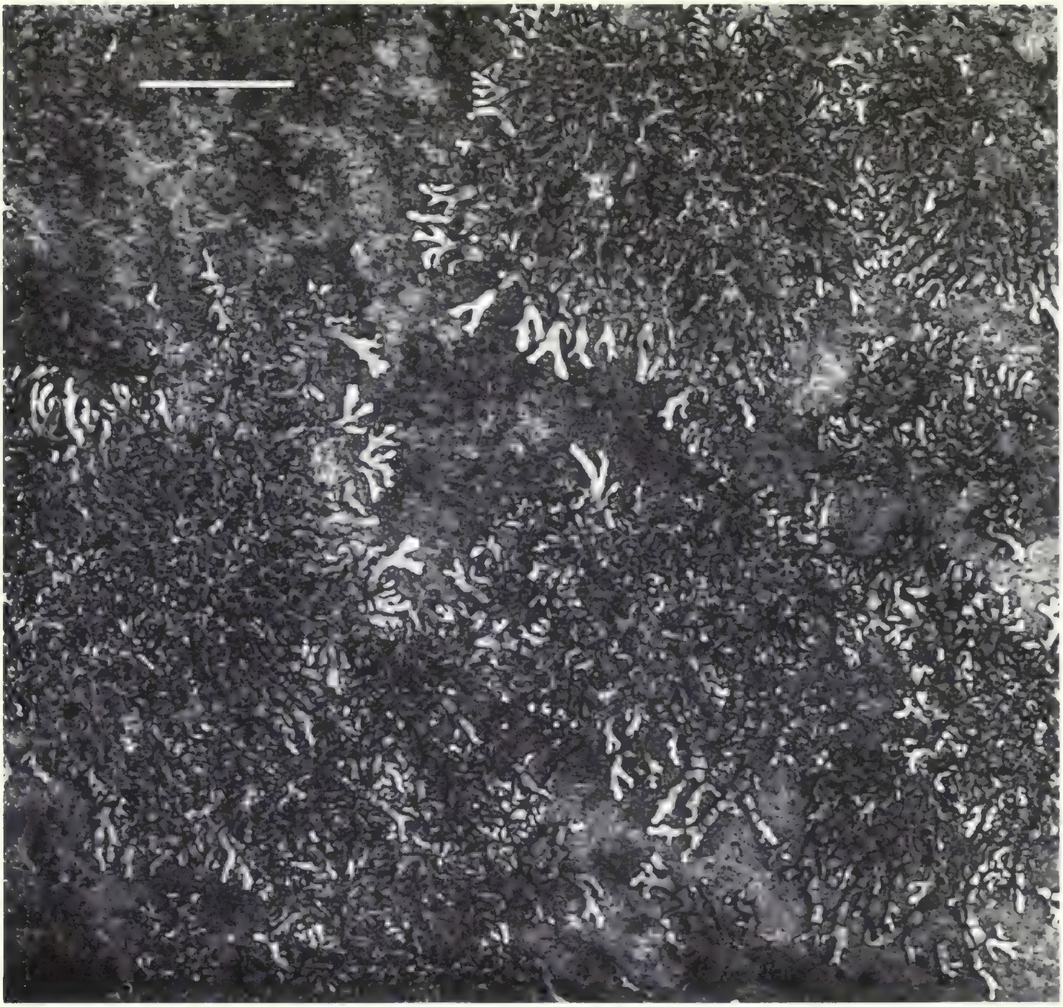


Fig. 27 *Xanthoparmelia louisii* Elix & Jen Johnston. Holotype in CBG. Scale = 0.5 cm.

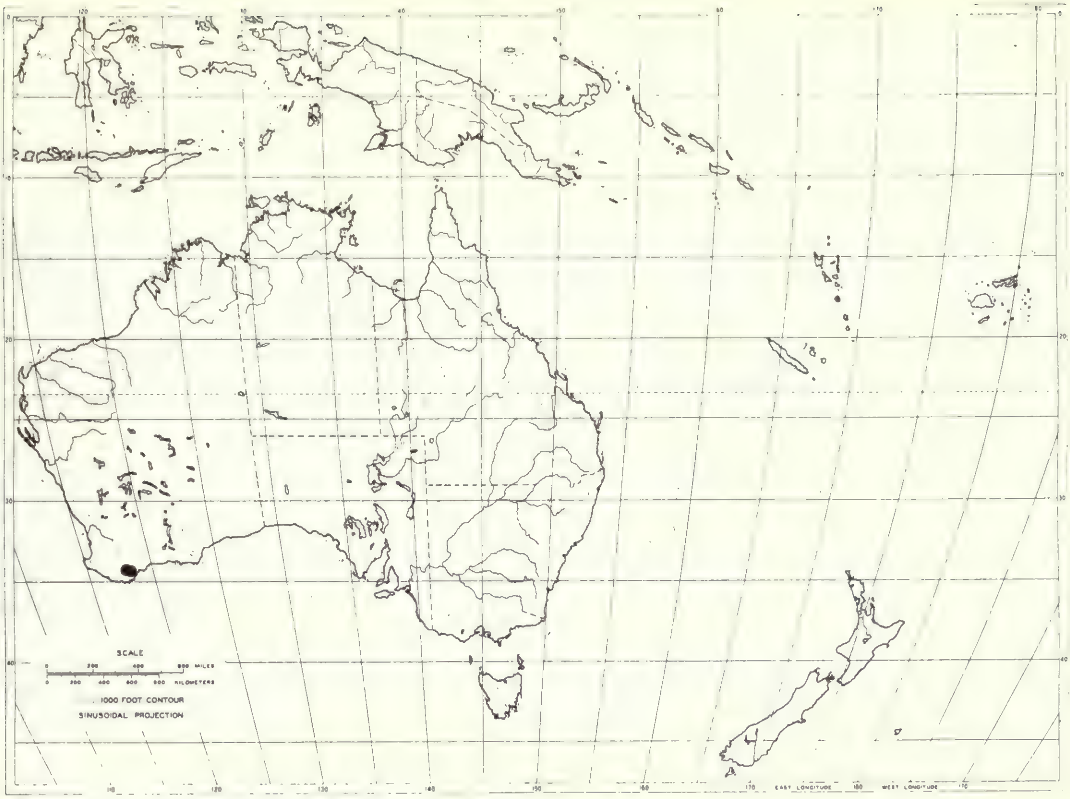
surface dark-brown to black, densely rhizinate, rhizines simple, black, or else lower surface adhaering directly to substrate. *Apothecia* common, substipitate to sessile, 0·5–1·0 mm diam., the disc black, exciple smooth, margin narrow, entire, ± crenulate; spores 6–10 × 5–7 μm.

CHEMISTRY. Cortex K−; medulla K−, C−, KC+ yellow, P−; containing usnic acid, barbatic acid, 4-*0*-demethylbarbatic acid, and traces of squamatic acid.

DISTRIBUTION. South-western WA. Map 62. On rocks in eucalypt forest. Specimens examined: 3.

NOTES. This species is characterised by its subcrustose thallus, tightly adnate lobes with a black lower surface, and the production of barbatic acid, 4-*0*-demethylbarbatic acid, and squamatic acid in the medulla.

Morphologically *X. louisii* closely resembles *X. adhaerens* and *X. donneri*, but *X. adhaerens* always contains stictic acid and constictic acid and *X. donneri* norstictic acid and barbatic acid, so they are readily distinguished chemically. Although these taxa could be considered chemical species, they do show different geographical distributions. *X. adhaerens* occurs in South Africa and is widely distributed in Southern Australia (WA, SA, Vic, NSW, and ACT), *X. donneri* occurs in SA and WA, while *X. louisii* appears to be restricted to south-western Western



Map 62 Distribution of *Xanthoparmelia louisii* in Australia.

Australia. These distinct distribution patterns coupled with the fact that the alternative metabolites are not closely related biosynthetically (Elix, 1982), convinced us to maintain these taxa as distinct species.

Chemically *X. louisii* is identical with another Australian species with a black lower surface viz., *X. burmeisteri*. However, the latter taxon has loosely adnate, dichotomously divided lobes with effigurate maculae on the upper surface, so morphologically it is quite dissimilar.

This species has been named in honour of Louis H. Elix, father and field companion.

X. louisii is a rarely collected but possibly overlooked species from south-western WA. It occurs on exposed rocks and pebbles in open eucalypt woodland and associates with *X. adhaerens, X. amplexula, X. mexicana,* and *X. xanthosorediata*.

63. **Xanthoparmelia luminosa** (Elix) Hale

in *Mycotaxon* **20**: 79 (1984).

≡ *Parmelia luminosa* Elix in *Aust. J. Bot.*: **29**: 357 (1981). Type: Australia, Australian Capital Territory, Gudgenby River Gorge, 4·5 km south of Tharwa, on granite rocks in dry sclerophyll forest, 660 m, *J. A. Elix* 6118 (MEL! – holotype; CBG! – isotype).

Illustration: Elix (op. cit.).

DESCRIPTION. *Thallus* foliose, adnate on rocks, bright yellow-green, but fading on storage, sometimes becoming deep olive-green with age, 6–10 cm wide; *lobes* subirregular, imbricate, contiguous or not, 2–5 (–8) mm wide, apices crenulate, ± rotund. *Upper surface* shiny, emaculate, becoming rugose and cracked with age, lacking soredia and isidia but with numerous pycnidia; medulla white for the most part, but lower medulla intense orange. *Lower surface* black but brown or often intense red-brown or orange-brown near lobe apices, moderately rhizinate, rhizines simple, robust, concolorous with lower cortex. *Apothecia* adnate, 2–5 mm diam., the margin involute at first but later becoming undulating and developing irregular cracks; spores 7–10 × 4·8–5·3 μm.

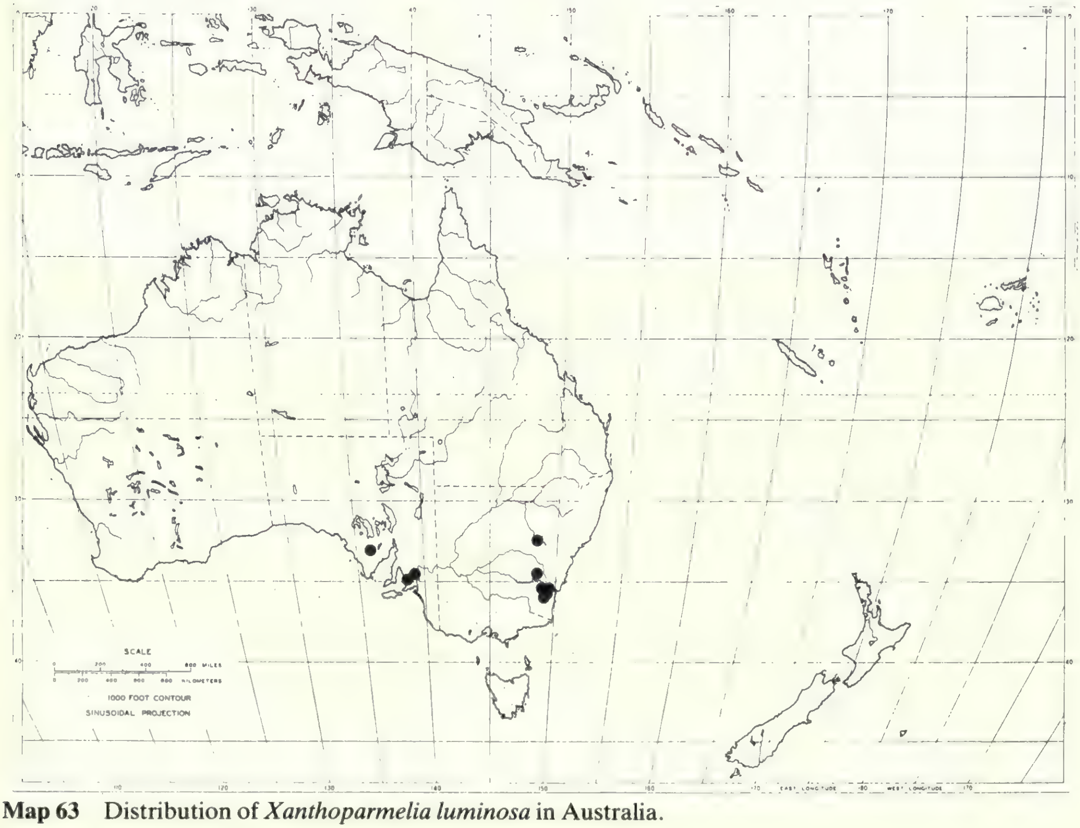
CHEMISTRY. Thallus K−; medulla K+ yellow then red, C−, KC−, P+ intense yellow; containing skyrin, usnic acid, salazinic acid, consalazinic acid.

DISTRIBUTION. South-eastern Australia (NSW, ACT, SA). Map 63. On rocks in temperate upland areas. Specimens examined: 14.

NOTES. In the field the most conspicuous feature of this broad-lobed species is the intense, shiny yellow-green colour of the upper cortex which appears almost luminous at times and readily differentiates this species from other co-occurring species of *Xanthoparmelia*. In cross-section the lower medulla of the lobes is orange or red-orange (skyrin), a feature found in only two other Australian species, namely *X. barbellata* and *X. ferruma*. The latter two species are readily distinguished by their pale lower surface, and moderate to dense rhizines. In *X. luminosa* the pigment skyrin is often readily apparent near the lobe apices where it imparts an intense reddish-brown or orange-brown coloration to the paler lower surface in this region.

Chemistry, growth habit, and lobe configuration of *X. luminosa* are reminiscent of *X. tasmanica* and a related South African species, *X. dichromatica*. However, lobes of *X. luminosa* and *X. dichromatica* are more tightly adnate and uniformly rhizinate than those of *X. tasmanica*. Although *X. dichromatica* also produces anthraquinones in the medulla, the pigments are concentrated near pycnidia rather than in the medulla adjacent to the lower cortex. Furthermore the lower surface of *X. dichromatica* is pale brown in contrast to the black lower surface of the Australian lichen.

X. luminosa is relatively common but scattered in south-eastern Australia, where it occurs on exposed acidic rocks in areas of moderate rainfall, together with *X. tasmanica, X. flavescentireagens, X. notata, X. scabrosa*, and *X. neotinctina*.



Map 63 Distribution of *Xanthoparmelia luminosa* in Australia.

64. **Xanthoparmelia mannumensis** (Elix) Elix & Jen Johnston, **comb. nov.**

Basionym: *Parmelia mannumensis* Elix in *Aust. J. Bot.* **29**: 359 (1981). Type: Australia, South Australia, along Gorge Creek, 10 km west of Mannum, on granite rocks, *J. A. Elix* 4215 (MEL! – holotype).
Illustration: Elix (op. cit.).

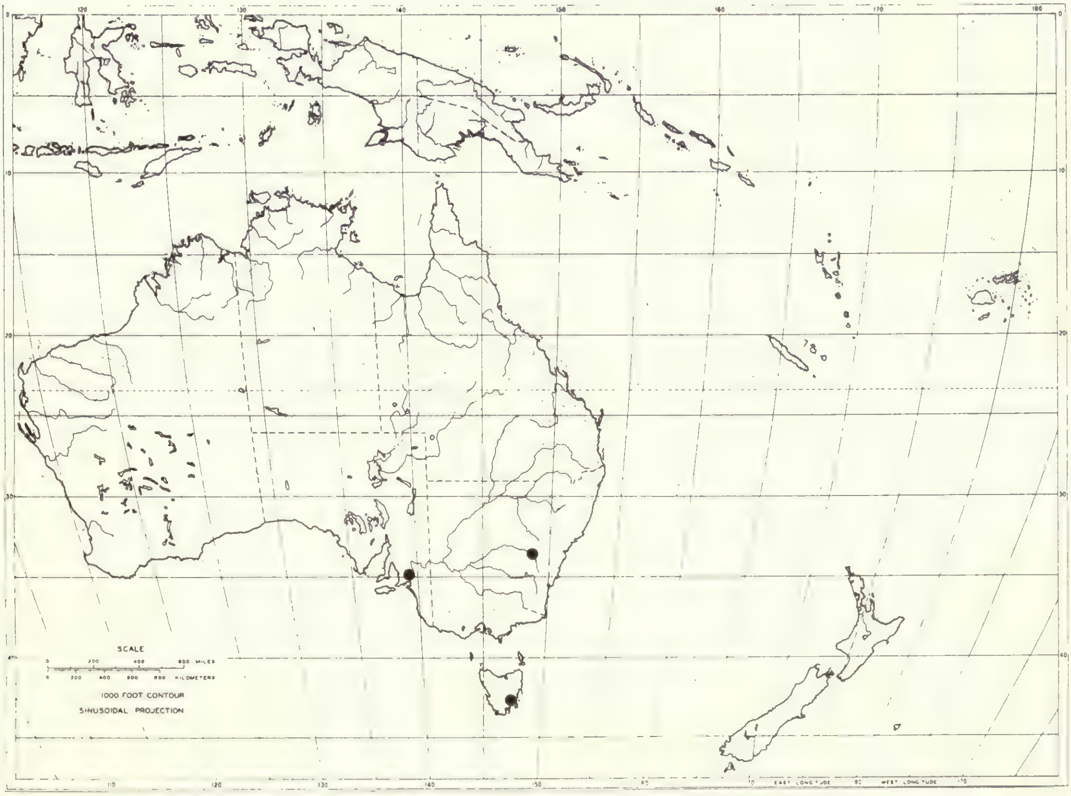
DESCRIPTION. *Thallus* foliose, loosely adnate on rocks, greenish yellow, subirregularly lobate, 7–10 cm diam.; *lobes* dichotomously to irregularly branched, narrow, sublinear-elongate, ± forming a rather thick mat or colony of densely imbricate lobes, 0·5–1·5(–2·0) mm wide. *Upper surface* distinctly to effigurately maculate, often black-margined particularly towards lobe apices, lacking soredia and isidia; medulla white. *Lower surface* black, rugulose or not, sparsely to moderately rhizinate, rhizines black, simple, robust. *Apothecia* subsessile, 2–5 mm diam., disc dark brown, exciple maculate; spores 6–8 × 4–5 μm.

CHEMISTRY. Thallus K−; medulla K−, C−, KC−, P−; containing usnic acid, diffractaic acid, trace quantities of barbatic acid, 4-*0*-demethylbarbatic acid, obtusatic acid, and norobtusatic acid.

DISTRIBUTION. SA, NSW. Map 64. Rare. On exposed rocks in subarid areas. Specimens examined: 4.

NOTES. Morphologically this species closely resembles *X. burmeisteri* and *X. pseudohypoleia*, as all three have similar loosely-adnate thalli which are narrow-lobate, have a black lower surface, and pronounced maculae on the upper surface. They belong to the *Xanthoparmelia hypoleia* group which are conveniently distinguished chemically as outlined in the key under *X. hypoleia*.

The major metabolites of *X. mannumensis* are usnic acid and diffractaic acid, and these compounds occur together with trace amounts of barbatic acid, 4-*0*-demethylbarbatic acid, obtusatic acid, and norobtusatic acid. The β-orcinol *para*-depside diffractaic acid is known in



Map 64 Distribution of *Xanthoparmelia mannumensis* in Australia.

three other species of *Xanthoparmelia* from Australia, viz., *X. everardensis, X. nashii*, and *X. tucsonensis*. *X. tucsonensis* however, has a brown lower surface and this species and *X. everardensis* are tightly adnate with broad lobes (1·0–3·0 mm wide) which lack maculae on the upper surface. *X. nashii* is distinguished by the presence of isidia.

X. mannumensis is a rare species found on exposed rocks associated with *Parmelia erumpens* Kurok., *Xanthoparmelia mexicana, X. flavescentireagens,* and *X. notata*.

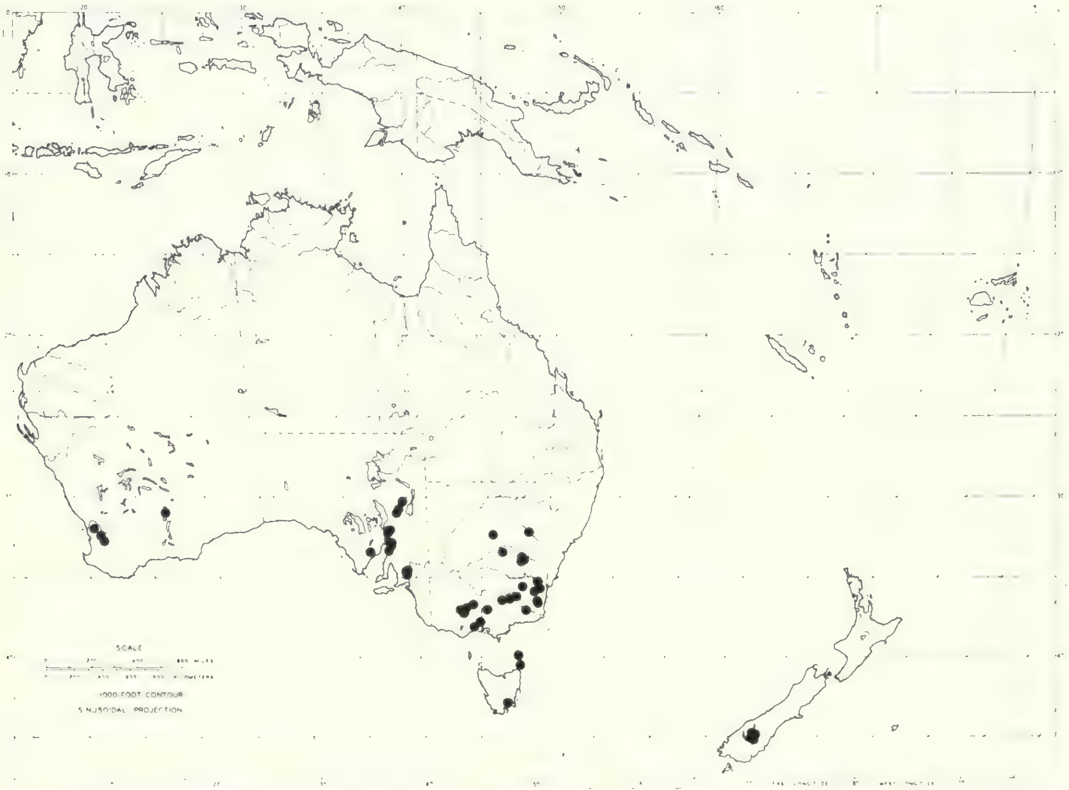
65. Xanthoparmelia metaclystoides (Kurok. & Filson) Elix & Jen Johnston, comb. nov.

Basionym: *Parmelia metaclystoides* Kurok. & Filson in *Bull. natn. Sci. Mus. Tokyo*, B, **1**: 40 (1975). Type: Australia, South Australia, Kimba to Cowell road, 18 km north-west of Cowell, growing over quartz and on to surrounding sandy gravel, 22 October 1970, *R. Filson* 11783 (MEL 1011810! – holotype).

Illustration: Kurokawa & Filson (op. cit.).

DESCRIPTION. *Thallus* foliose, adnate to tightly adnate on rocks or dead wood, 6–10(–12) cm wide, pale yellow-green, darkening to olive-green or blackish with age, subirregularly lobate, sparingly imbricate; *lobes* irregular, 0·7–2·5(–3·5) mm wide, marginal lobes subrotund, blackened at margins, occasionally developing lobules centrally. *Upper surface* opaque, flat, emaculate, older central lobes becoming wrinkled, dull and blackened, lacking soredia and isidia; medulla white. *Lower surface* pale ivory to pale brown or blackening near lobe apices, moderately rhizinate, rhizines brown to black, simple. *Apothecia* adnate, to 7 mm diam., disc brown to dark brown; margin inrolled at first but disc becoming flat and margin undulate with age; spores 9–10 × 6 μm.

CHEMISTRY. Thallus K−; medulla K+ yellow becoming red, C−, P+ yellow-orange; containing usnic acid, norstictic acid, connorstictic acid, salazinic acid (±), constipatic acid (±), and protoconstipatic acid (±).



Map 65 Distribution of *Xanthoparmelia metaclystoides* in Australia and New Zealand.

Distribution. Southern Australia (NSW, ACT, Vic, Tas, SA, WA) and South Island, New Zealand (Canterbury, Otago). Map 65. On rocks in arid, subarid areas, and dry subalpine grasslands. Specimens examined: 93.

Notes. The aliphatic acids, constipatic acid and protoconstipatic acid, present in the holotype of *X. metaclystoides* are considered to be accessory metabolites in this taxon.

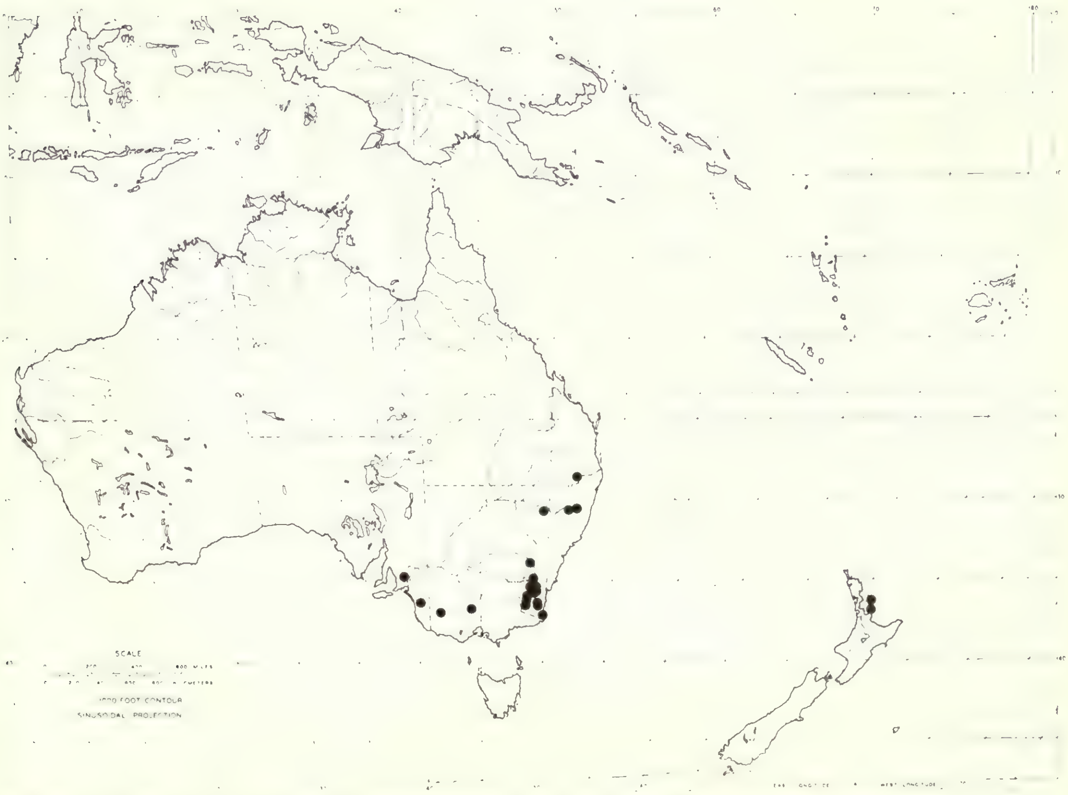
This species is characterised by the tightly adnate lobes with subrotund apices and a pale lower surface. In these respects it closely resembles *X. lineola*, but the marginal lobes are irregular rather than sublinear-elongate as in *X. lineola*, and these species differ chemically. For a key to this group refer to *X. lineola*.

Xanthoparmelia metaclystoides is chemically identical with *X. elixii*, but the latter species has loosely adnate lobes and commonly develops narrow, sublinear-elongate secondary lobes which may be ± subascending at the apices or occasionally the highly imbricate lobes build up the thallus into a thick mat. These features are not seen in *X. metaclystoides*. Furthermore, the lower surface of the lobes of *X. metaclystoides* are more densely rhizinate than those of *X. elixii*.

A group of specimens from the Mackenzie Country in South Island, New Zealand, are atypical in the extensive production of lobules in the centre of the thallus; this is probably the result of abrasion by windborne sand particles, or of other environmental factors.

X. metaclystoides is a relatively common species on rocks in the drier areas of Australia and New Zealand where it is often associated with *X. lineola, X. ustulata, X. substrigosa,* and *X. flavescentireagens*.

66. **Xanthoparmelia metamorphosa** (Gyelnik) Hale



Map 66 Distribution of *Xanthoparmelia metamorphosa* in Australia and New Zealand.

in *Phytologia* **28**: 488 (1974).

≡ *Parmelia metamorphosa* Gyelnik in *Annls mycol.* **36**: 284 (1938). Type: Australia, New South Wales, Eden, *Cheel* (BP! – holotype).

Illustration: Fig. 28.

DESCRIPTION. *Thallus* foliose, saxicolous, loosely attached to the substrate, yellow-green, 4–6 cm diam.; *lobes* linear-elongate, dichotomously divided, very narrow, 0·3–0·6 mm wide, often subascending at apices exposing lower surface. *Upper surface* smooth, shining, maculate, lacking soredia and isidia, margins shining black or brown; medulla white. *Lower surface* ivory to pale brown, darker towards the apices, shining or matt, wrinkled, very sparsely rhizinate, rhizines concolorous with lower surface, simple, robust. *Apothecia* adnate, 1·5–8·0 mm wide, disc concave at first, becoming flattened and distorted with age, brown to dark brown, margin thin, inrolled at first, crenulate, becoming deeply lacerate; spores 8–10 × 4–5·5 μm.

CHEMISTRY. Thallus K−; medulla K−, C−, KC+ rose, P−; containing usnic acid, loxodin, norlobaridone.

DISTRIBUTION. Eastern Australia (Qld, NSW, ACT, Vic, SA) and North Island, New Zealand. Map 66. On exposed rocks in areas of higher rainfall. Specimens examined: 35.

NOTES. This species is characterised by the linear-elongate, dichotomously divided, very narrow lobes with a pale lower surface. It resembles *X. furcata* both chemically and morphologically, but has consistently narrower, divaricate lobes (less than 0·6 mm wide) and a paler undersurface. The lower surface is pale ivory to pale brown in *X. metamorphosa* and brown to

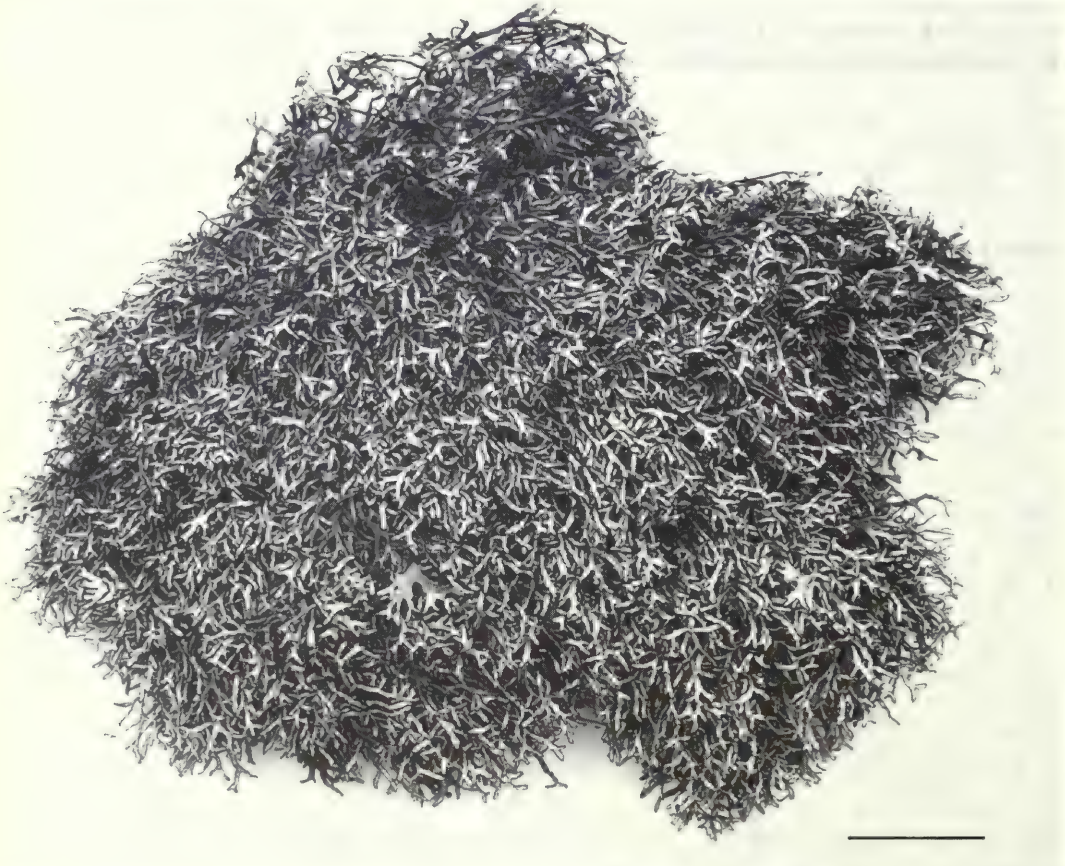


Fig. 28 *Xanthoparmelia metamorphosa* (Gyelnik) Hale. *Elix* 1513 in ANUC. Scale = 1 cm.

chocolate-brown in *X. furcata*. More particularly the upper surface is maculate in *X. metamorphosa* in contrast to the shiny, emaculate lobes of *X. furcata*.

X. metamorphosa is relatively rare and scattered in areas of moderate to higher rainfall in south-eastern Australia. Here it usually occurs with *X. eradicata, X. tasmanica, X. cheelii, X. flavescentireagens,* and *X. furcata*. It appears to be much rarer in New Zealand.

67. **Xanthoparmelia metastrigosa** (Elix) Hale

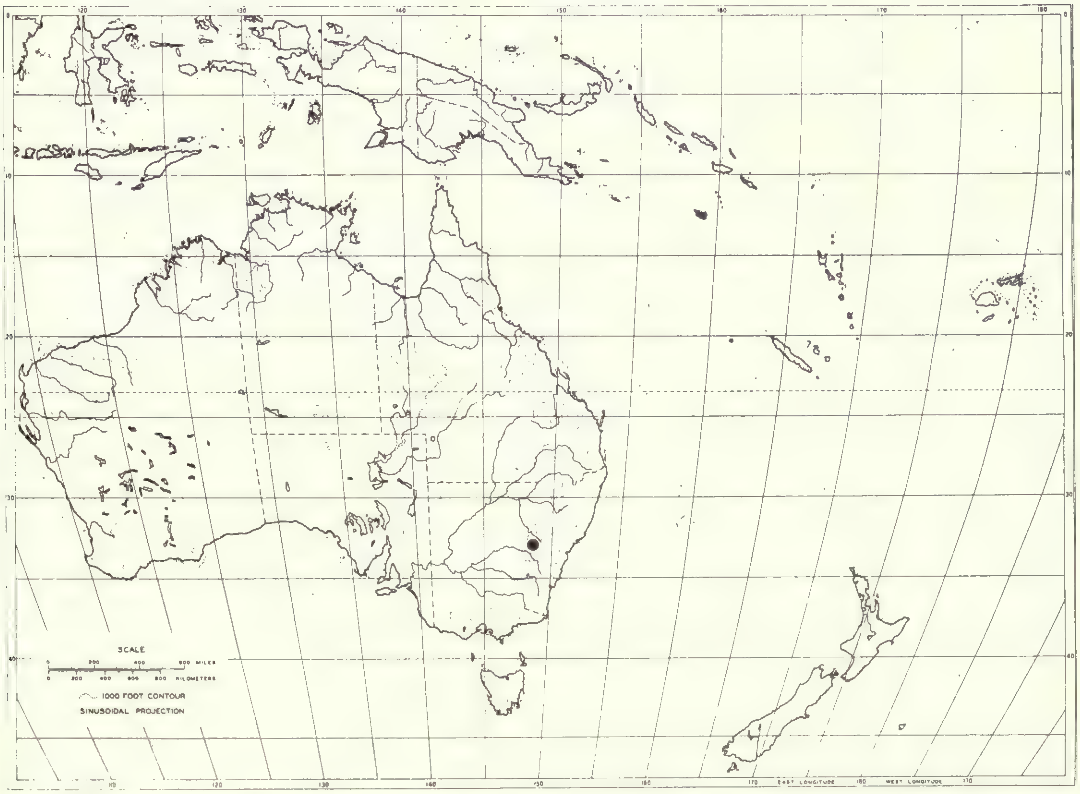
in *Mycotaxon* **20**: 79 (1984).

≡ *Parmelia metastrigosa* Elix in *Aust. J. Bot.* **29**: 360 (1981). Type: Australia, New South Wales, north-east slopes of Mount Canobolas near Orange, on soil and rocks in dry sclerophyll forest, 1320 m, *J. A. Elix* 4627 (MEL! – holotype).

Illustration: Elix (op. cit.).

DESCRIPTION. *Thallus* foliose, loosely adnate on rocks and soil, yellow-green, irregularly lobate, 7–12 cm diam.; *lobes* linear-elongate, dichotomously or irregularly divided, subascending or not, very rarely or not at all imbricate, margins broadly sinuate, 1·5–4(–5) mm wide. *Upper surface* shiny but becoming opaque with age, emaculate, commonly convex and with black margins, lacking soredia and isidia but with numerous pycnidia; medulla white. *Lower surface* ± canaliculate, pale brown to dark blackish-brown, with very dense, brush-like rhizines, rhizines concolorous with lower surface, simple or often dichotomously branched. *Apothecia* substipitate, large, 10–12 mm diam., disc dark brown, becoming flattened or slightly convex, margin entire, undulating; spores 8·5–10·5 × 4·5–5·5 μm.

CHEMISTRY. Thallus K−; medulla K− or K+ reddish, C−, KC−, P−; containing usnic acid, hypostictic acid, hyposalazinic acid, and hypoconstictic acid.



Map 67 Distribution of *Xanthoparmelia metastrigosa* in Australia.

Distribution. NSW, near Orange. Map 67. On exposed, subalpine rocks. Specimens examined: 7.

Notes. Morphologically this species closely resembles *X. substrigosa* as both possess loosely adnate thalli, broadly sinuate lobes, and characteristic very thick, brush-like rhizines. The lower surface of both species varies from pale brown (particularly in older lobes) to almost black and they are rare among species of *Xanthoparmelia* in having often dichotomously branched rhizines. However, they are clearly separated by their chemical constituents since *X. substrigosa* contains usnic, norstictic, and salazinic acids, and *X. metastrigosa* contains usnic, hypostictic, hyposalazinic, and hypoconstictic acids. Morphologically *X. metastrigosa* differs in having markedly convex lobes with a canaliculate lower surface, while the lobes are more or less flat in *X. substrigosa*.

X. metastrigosa is chemically similar to *X. subcrustacea* but thalli of the latter species are tightly adnate on rocks and form areolae centrally. The short, simple rhizines of *X. subcrustacea* are also unlike those of *X. metastrigosa*.

X. metastrigosa appears to have a very restricted distribution. To date it is known only from Mt Canobolas where it is common.

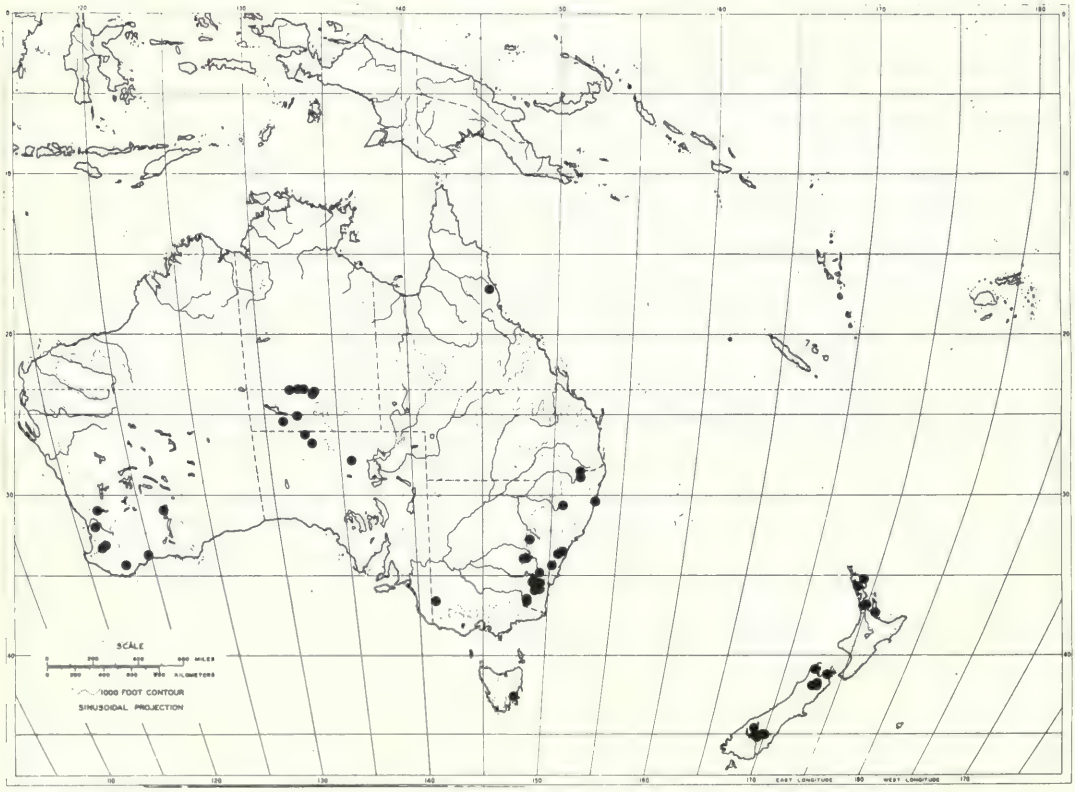
68. **Xanthoparmelia mexicana** (Gyelnik) Hale

in *Phytologia* **28**: 488 (1974).

≡ *Parmelia mexicana* Gyelnik in *Reprium nov. Spec. Regni veg.* **29**: 281 (1931). Type: Mexico, San Jeronima, *F. Amable* 676 (BP – holotype; US! – isotype).

Illustration: Yoshimura, *Lichen Flora Japan Colour*: plate 13 no. 97 (1977).

Description. *Thallus* foliose, tightly to moderately appressed to substrate, yellow-green, 5–10 cm diam., *lobes* irregular, elongate, imbricate, 1–2(–5) mm wide, apices rounded or shallowly



Map 68 Distribution of *Xanthoparmelia mexicana* in Australia and New Zealand.

notched. *Upper surface* shining, emaculate, smooth at margins, becoming wrinkled centrally, margins blackened and slightly thickened, isidiate, *isidia* laminal, not at margins, cylindrical, short, slender or slightly inflated, becoming coralloid, densely covering central portion of thallus; *lower surface* pale tan to brown, or rarely dark brown in places, shining, moderately to sparsely rhizinate, rhizines short, simple or rarely dichotomously branched, concolorous with lower surface. *Apothecia* adnate, 2–8 mm diam., disc red-brown to dark brown, shining, margin entire, rather thin, often disappearing in mature fruits, exciple smooth, shining, isidiate; spores 8–10 × 6–7 μm.

CHEMISTRY. Thallus K−; medulla K+ yellow becoming red, C−, KC−, P+ orange; containing usnic acid, salazinic acid, consalazinic acid, and rarely traces of norstictic acid, protoconstipatic acid (±), and constipatic acid (±).

DISTRIBUTION. Australia (Qld, NSW, ACT, Vic, Tas, SA, WA, NT), and New Zealand. Map 68. Also in Mexico, USA, Japan. On rocks and dead wood in arid, subarid, and areas of moderate rainfall. Specimens examined: 98.

NOTES: *Xanthoparmelia mexicana* is characterised by broad lobes, dense, branched isidia, a pale lower surface and the production of usnic and salazinic acids. The closely related species *X. succedans* differs in having moderate, simple isidia (rarely branched), and in producing usnic acid, stictic acid, and constictic acids as major metabolites.

Morphologically *X. mexicana* resembles *X. weberi*, a much rarer species from central Australia, but the isidia of *X. weberi* ultimately become inflated and erumpent, a feature not observed in *X. mexicana*. These species may also be differentiated chemically, since *X. weberi* produces hypoprotocetraric acid (K−) rather than the salazinic acid of *X. mexicana* (K+ yellow-red).

X. mexicana is chemically identical with *X. antleriformis*, which also has a pale lower surface and produces isidia. However, lobes of *X. antleriformis* are much narrower and sublinear elongate, and the isidia more robust and extensively coralloid.

X. mexicana is a variable, widespread species occurring on rocks from very arid to moist habitats. It is usually associated with *X. scabrosa, X. flavescentireagens*, and *X. tasmanica*.

69. Xanthoparmelia molliuscula (Ach.) Hale

in *Phytologia* **28**: 488 (1974).

≡ *Parmelia molliuscula* Ach., *Lich. Univ.*: 492 (1810). Type: South Africa, Cap. Bonae Spei, *Thunberg* (H-Ach. – holotype; UPS-Ach. – isotype).

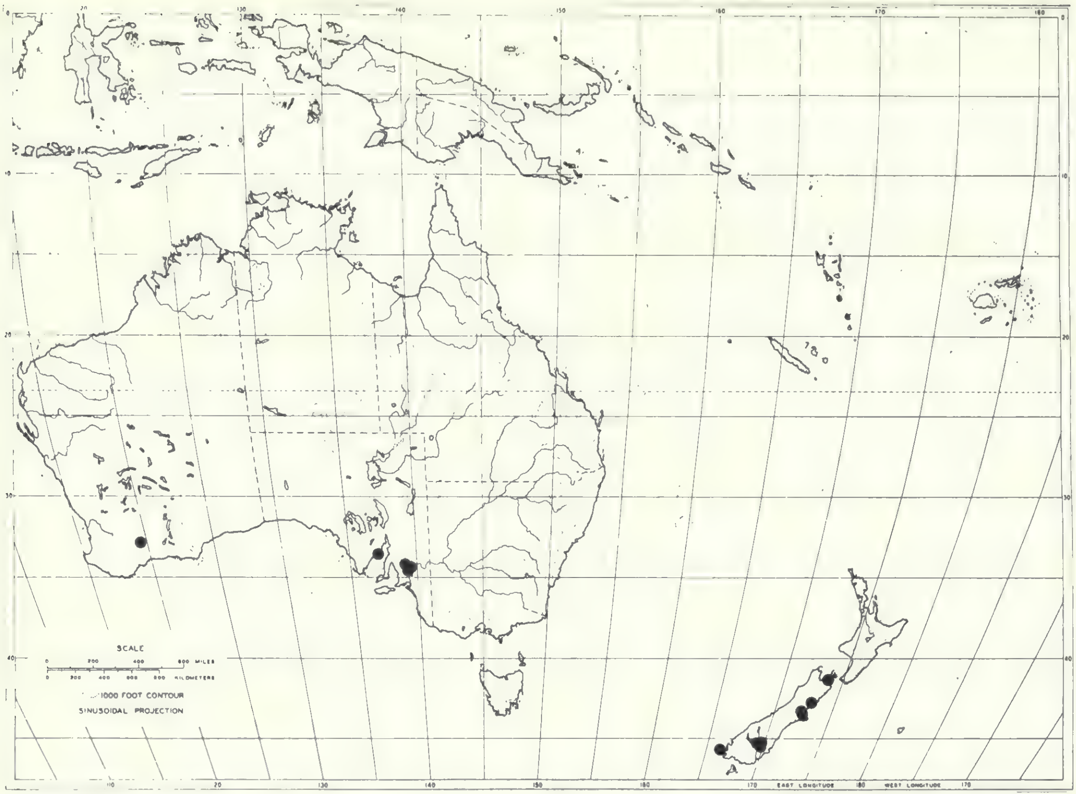
= *Parmelia thamnidiella* Stirton in *Trans. Glasg. Soc. Field Nat.* **5**: 213 (1877). Type: South Africa, Somerset East, *P. MacOwen* (GLAM – lectotype).

= *Parmelia subpumila* Elix in *Aust. J. Bot.* **29**: 372 (1981). Type: Australia, South Australia, 20 km west of Swan Reach along the Sedan road, on soil in mallee scrub, *J. A. Elix* 2765 (MEL! – holotype; CBG! – isotype).

Illustrations: Elix (loc. cit.) (as *Parmelia subpumila*); Galloway in *N.Z. Jl Bot.* **18**: 539 (1981).

DESCRIPTION. *Thallus* foliose, unattached or loosely adnate on soil, yellow to yellow-green, forming rosettes 4–6 cm diam.; *lobes* subirregular to subdichotomously divided, narrow at apices (0·7–1·5 mm) but wider at base (to 6 mm), lobulate centrally, lobules extensively branched, ascending, subterete to cylindrical, sometimes black-tipped at apices, 0·2–0·4 mm wide. *Upper surface* convex, glossy or opaque, smooth but becoming rugulose with age, often black-margined, lacking soredia and isidia; medulla white; *lower surface* ± canaliculate, pale yellow-brown to dark brown, shining, wrinkled, shallowly faveolate, rhizines sparse to moderate, simple, tufted or branched, ± dichotomously or palmately divided, brown to black. *Apothecia* (in South African specimens) very rare, substipitate, *c.* 1–2 mm diam., disc pale brown, margin entire, thick, undulate, exciple smooth, shining; spores 6–9 × 3·5–5·5 μm.

CHEMISTRY. Thallus K−; medulla K+ yellow-orange, C−, P+ orange; containing usnic acid, stictic acid (major), constictic acid, norstictic acid (minor), cryptostictic acid (trace), and associated unknown (± trace).



Map 69 Distribution of *Xanthoparmelia molliuscula* in Australia and New Zealand.

Distribution. Southern Australia (SA, WA), South Island, New Zealand. Map 69. Also in South Africa. On soil in arid, subarid, and dry subalpine areas. Specimens examined: 38.

Notes. This terricolous species closely resembles *Xanthoparmelia terrestris* in that both species are often characterised by the development of highly branched lobules in the centre of the thallus, and have ± convex lobes with a pale lower surface. Lobules are flat or revolute in *X. terrestris*, but terete in *X. molliuscula*. Furthermore, *X. terrestris* forms much more extensive and irregular thalli which occasionally do not develop lobules, and produces usnic acid, norstictic acid, and salazinic acid.

Chemically *X. molliuscula* is identical to *X. amphixantha*, another rosette-forming terricolous species. *X. amphixantha* has only weakly convex lobes which lack lobules and develops distinct maculae near the lobe apices.

X. molliuscula belongs to the *X. versicolor* group, a key to which is included under *X. versicolor*.

X. molliuscula is a terricolous species, scattered on arid soils in the mallee areas of southern Australia, and the drier areas (Central Otago, north Canterbury, Marlborough) of South Island, New Zealand. It commonly occurs with *X. reptans, X. amphixantha, X. concomitans*, and *Chondropsis semiviridis* (Nyl.) Nyl.

70. **Xanthoparmelia mougeotina** (Nyl.) D. Galloway

N.Z. Jl Bot. **18**: 538 (1981).

≡ *Parmelia mougeotina* Nyl., *Lich. Nov. Zel.*: 27 (1888). Type: New Zealand, *C. Knight* (H-NYL – 34661! – holotype).

≡ *Parmelia mougeotii* f. *mougeotina* (Nyl.) Gyelnik in *Annls hist.-nat. Mus. natn. hung.* **31** (Bot): 32 (1938).

= *Parmelia mougeotii* var. *obscurata* Müll. Arg. in *Bull. Soc. r. Bot. Belg.* **31**: 30 (1892). Type: New Zealand, Otago, Glen Martin, Saddle Hill near Dunedin, on mica slate rocks, 6 November 1861, *W. L. Lindsay* (BM – isotype).

= *Parmelia congensis* B. Stein in *Jber. schles. Ges. vaterl. Kult.* **66**: 140 (1889). Type: Africa, Congo, Vivi, *Ledien* 32 (G – lectotype).

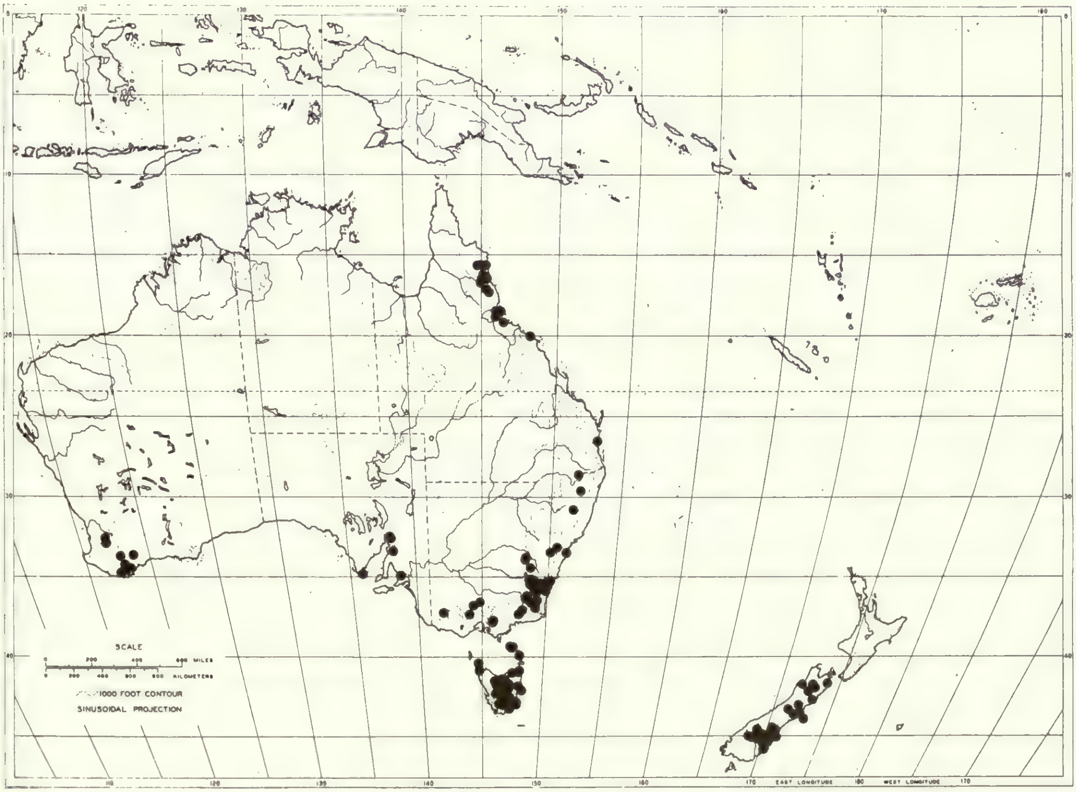
≡ *Xanthoparmelia congensis* (B. Stein) Hale in *Phytologia* **28**: 486 (1974).

Illustration: Galloway in *N.Z. Jl Bot.* **18**: 540 (1981).

DESCRIPTION. *Thallus* foliose to subcrustose, closely appressed, pale yellow-green, darkening to yellow-brown or black centrally, 3–5(–8) cm diam., ± rosette forming; *lobes* narrow, 0·5–1·0 (–1·5) mm wide, stellate or rarely contiguous, not at all imbricate, apices markedly incised. *Upper surface* flat to slightly concave, shining at apices, dull and irregularly cracked centrally, becoming crustose-areolate with age, isidiate, *isidia* small (0·1–0·2 mm), simple, globose or ± distorted cylindrical, brown-tipped, ± inflated at apices, fragile to robust, sparse, at centre of thallus and on marginal lobes; lacking maculae and soredia; medulla white. *Lower surface* black to dark brown, smooth, shining, sparsely rhizinate, rhizines simple, black. *Apothecia* rare, sessile, to 1 mm diam., disc concave to plane, dark brown, margins prominent, entire, exciple smooth, without isidia; spores 7–9 × 5–6·5 μm.

CHEMISTRY. Thallus K−; medulla K+ yellow, C−, KC−, P+ orange; containing usnic acid, stictic acid, constictic acid, norstictic acid (minor), cryptostictic acid (trace), rarely menegazziaic acid (± trace), and associated unknown (± trace).

DISTRIBUTION. Australia (Qld, NSW, ACT, Vic, Tas, SA, WA), and New Zealand. Map 70. Known also from South Africa, Uganda, India, Hong Kong, and Brazil. Common and widespread on rocks in areas of moderate to higher rainfall. Specimens examined: 316.



Map 70 Distribution of *Xanthoparmelia mougeotina* in Australia and New Zealand.

NOTES. This species is easily recognised by the tightly adnate, diminutive, ± subcrustose thallus with narrow, radiating lobes usually growing in well-defined rosettes, the black or dark brown lower surface, and the presence of isidia. In some alpine areas the lobes are somewhat broader and more or less contiguous, but still radiate at the margin. *X. mougeotina* resembles *X. consociata* in most features, but the latter has a pale lower surface and contains norstictic acid and salazinic acid in addition to usnic acid, while *X. mougeotina* produces usnic acid, stictic acid, and constictic acid and only traces of norstictic and cryptostictic acids. *X. mougeotina* is virtually the only species of *Xanthoparmelia* in the study region that becomes truly corticolous – in Kosciusko National Park it is often collected growing on twigs of *Podocarpus lawrencii*. This species is often also found growing on broken glass.

X. mougeotina also resembles *X. crateriformis* and *X. phillipsiana*, but the distinctive features of these are discussed separately under each. *X. mougeotina* is chemically identical with the common isidiate northern hemisphere species, *X. conspersa* (Ach.) Hale, but it has broader lobes with subrotund apices and does not occur in Australasia. The counterpart to *X. mougeotina* in the northern hemisphere is *X. mougeotii* (Pers.) Hale, a species with an analogous growth habit and an identical chemistry, but distinguished by the production of soredia as opposed to isidia.

X. mougeotina is a particularly common and widespread species in south-eastern Australia and South Island, New Zealand. Common associates include *Cladia aggregata* (Swartz) Nyl., *Neofuscelia pulla* (Ach.) Essl., *Lecidea aspidula* Krempelh., *Xanthoparmelia filarszkyana, X. lineola, X. scabrosa*, and *X. neotinctina*.

71. **Xanthoparmelia multipartita** (Crombie) Hale

in *Mycotaxon* **20**: 79 (1984).

≡ *Parmelia conspersa* var. *multipartita* Crombie in *J. Linn. Soc.* (Bot.) **17**: 394 (1880). Type: Australia, New South Wales, on rocks near Port Jackson, *R. Brown* 542 (BM! – holotype; BM! – isotype).

≡ *Parmelia multipartita* (Crombie) Elix in *Aust. J. Bot.* **29**: 361 (1981).

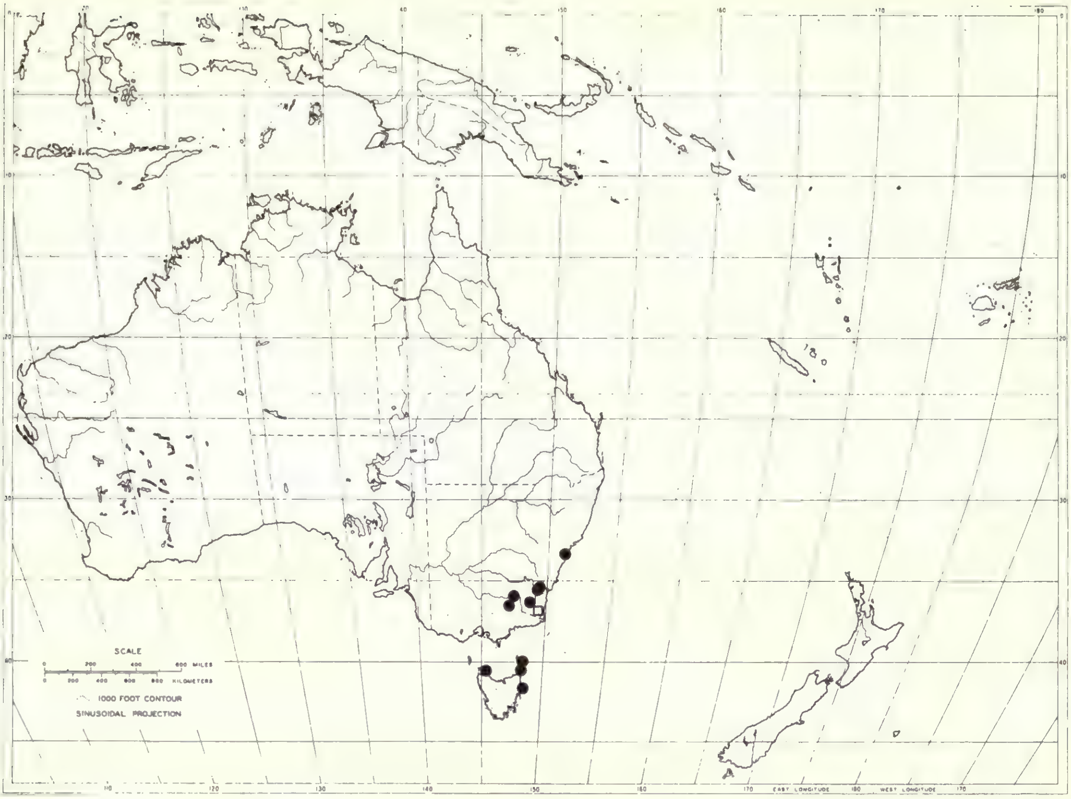
Illustration: Elix (op. cit.).

DESCRIPTION. *Thallus* foliose, very loosely adnate on rocks, yellow to yellow-green, becoming brownish on long storage, blackening with age, 6–9 cm diam.; *lobes* linear-elongate, subdichotomously branched, divaricate in places, moderately imbricate, becoming suberect and exposing black lower surface, 0·5–1·0 mm wide. *Upper surface* smooth, shiny, emaculate, lacking soredia and isidia but with numerous pycnidia and black margins; medulla white. *Lower surface* jet black for the most part, wrinkled, with very sparse rhizines present or absent, rhizines simple, short, robust. *Apothecia* adnate, 1·0–3·0(–10·0) mm diam., disc chestnut brown at first, darkening with age, margins entire, thick and involute at first, becoming thin and subentire with age; spores 6–10 × 3·5–5·5 μm.

CHEMISTRY. Thallus K−; medulla K+, pale reddish, C−, KC−, P−; containing usnic acid, hypostictic acid, hyposalazinic acid, hypoconstictic acid (±).

DISTRIBUTION. South-eastern Australia (NSW, ACT, Vic, Tas). Map 71. Loosely adnate on rocks in areas of moderate rainfall. Specimens examined: 16.

NOTES. *Xanthoparmelia multipartita* belongs to the *X. subnuda* group of species characterised by loosely adnate thalli with linear-elongate, di- or trichotomously divided lobes, and a black, rugulose, sparsely rhizinate lower surface. These species are most reliably distinguished chemically, and a key is given under *X. subnuda*. Three species, *X. multipartita, X. eradicata,* and *X. subnuda*, are further characterised by subascending lobe apices, and, although they exhibit few morphological distinctions, *X. multipartita* contains hypostictic and hyposalazinic acids, *X. eradicata* contains salazinic acid, and *X. subnuda* contains norstictic acid, connorstictic acid, and variable quantities of salazinic acid. Within Australia, *X. subnuda* is much more widely distributed than the other two species and this distinctive distribution pattern coupled with the absence of chemical combinants attests to the species status of this taxon (Elix, 1982). Although *X. multipartita* and *X. eradicata* are generally sympatric in Australia, they maintain their



Map 71 Distribution of *Xanthoparmelia multipartita* in Australia.

chemical integrity throughout, so are given species status in this revision. *X. eradicata* also occurs in South Africa.

Although *X. multipartita* resembles *X. quintaria* (Hale) Hale, in chemistry, the suberect lobes with a black lower surface are dissimilar to those of the latter species which possesses compact, densely imbricate lobes with a brown lower surface.

X. multipartita is a rare, but widely dispersed species usually found on exposed, acidic rocks in dry sclerophyll forests of eastern Australia. It is commonly found in colonies with *X. hypoprotocetrarica, X. tasmanica, X. notata*, and *X. subnuda*.

72. **Xanthoparmelia nashii** Elix & Jen Johnston, **sp. nov.**

Thallus ut in *Xanthoparmelia isidiigera* sed acidum diffractaicum et acidum barbaticum et acidum 4-*0*-demethylbarbaticum et acidum 3-α-hydroxybarbaticum continenti differt. Superficies superior isidiata, isidiis cylindricis, simplicibus demum parce ramosis. Superficies inferior nigra, modice rhizinata, rhizinis simplicibus, concoloribus. Thallus 130–210 μm crassus; cortex superior 20–28 μm crassus, stratum gonidiale 20–35 μm crassum, medulla 65–140 μm crassa, cortex inferior 7–12 μm crassus. Thallus K−, medulla K−, C−, KC−, P−.

Type: Australia, Western Australia, King Rocks, 30 km north-east of Hyden, on granite rocks, 8 August 1981, *T. H. Nash* 20392 (Herb. Arizona State University! – holotype).
Illustration: Fig. 29.

DESCRIPTION. *Thallus* foliose, adnate to rocks, yellow-green, darkening with age, 5–6 cm diam.; *lobes* sublinear-elongate, imbricate or not, 1–2(–3) mm wide, occasionally with narrower secondary lobes overlaying centre of thallus. *Upper surface* smooth, shiny at least near apices, emaculate, flat to slightly concave, margins often blackened, particularly towards apices, without soredia, isidiate, *isidia* dense, simple, cyclindrical or at length sparingly branched;

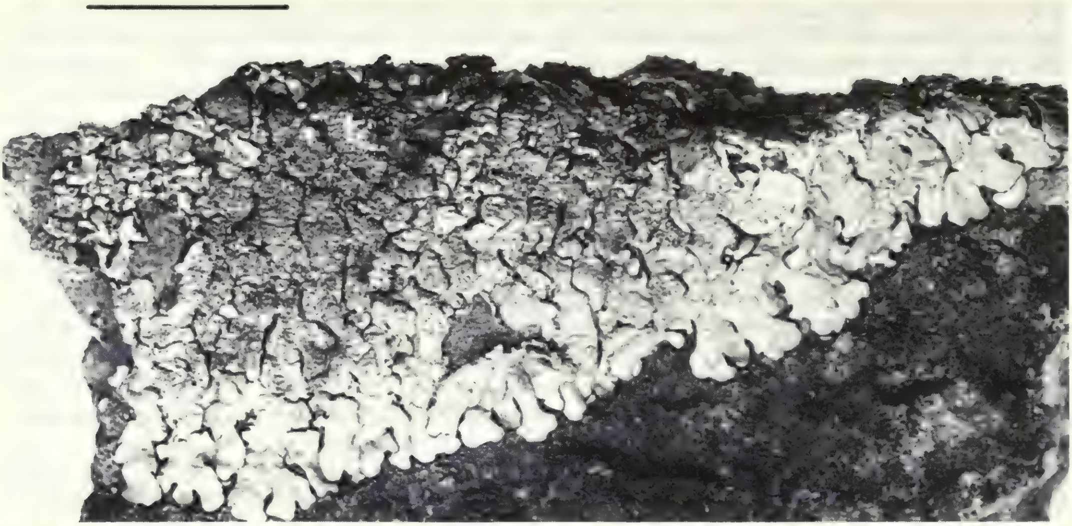
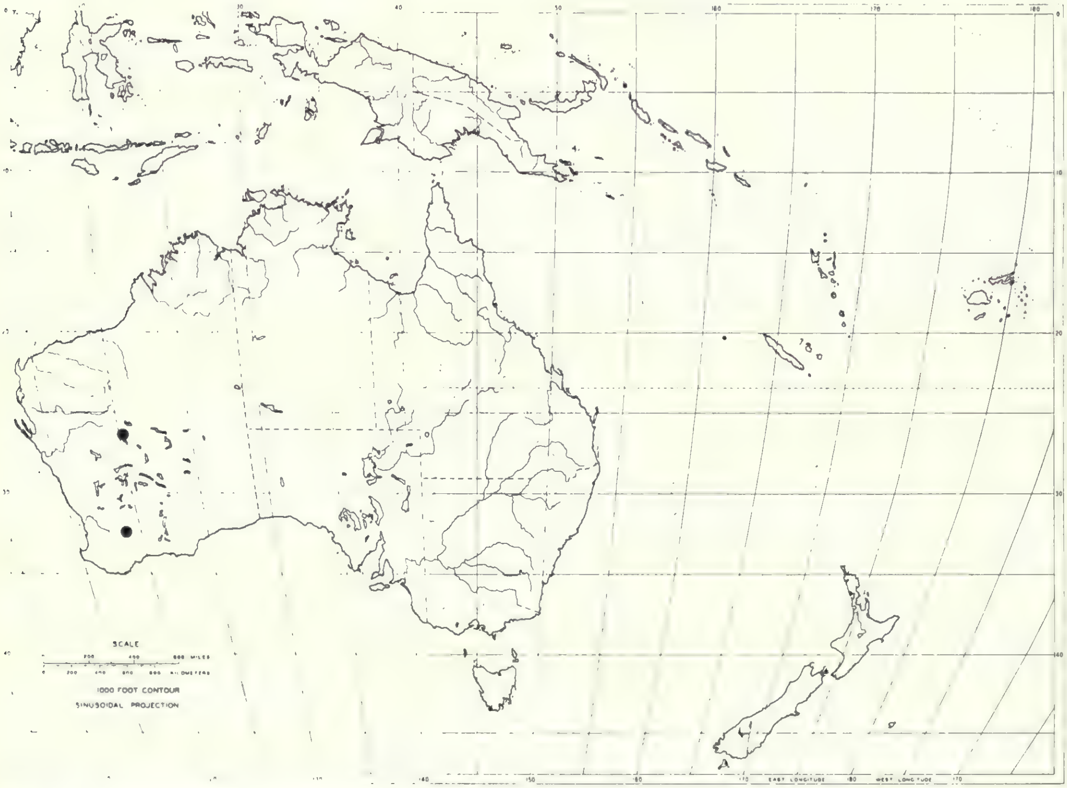


Fig. 29 *Xanthoparmelia nashii* Elix & Jen Johnston. Holotype in Herb. Arizona State Univ. Scale = 1 cm.

medulla white. *Lower surface* black, dull, smooth, sparsely to moderately rhizinate, rhizines slender, short, 0·3–0·5 mm long, simple, black. *Apothecia* not seen.

CHEMISTRY. Thallus K−; medulla K−, C−, P−, KC−; containing usnic acid, diffractaic acid (major) and traces of barbatic acid, 4-*0*-demethylbarbatic acid and 3α-hydroxybarbatic acid.


SCALE
MILES
KILOMETERS
1000 FOOT CONTOUR
SINUSOIDAL PROJECTION
EAST LONGITUDE
WEST LONGITUDE

Map 72 Distribution of *Xanthoparmelia nashii* in Australia.

DISTRIBUTION. South-western Western Australia. Map 72. On rocks in a sub-arid area. Specimens examined: 2.

NOTES. This species resembles *Xanthoparmelia isidiigera* in morphology. Both species have narrow lobes with a black lower surface and produce cylindrical isidia on the upper surface. However, *X. isidiigera* is generally more loosely adnate than *X. nashii* and the two differ chemically; *X. isidiigera* contains usnic and salazinic acids (K+ yellow-red) rather than the usnic and diffractaic acids (K−) present in *X. nashii*.

Chemically and morphologically *X. nashii* resembles *X. vicaria* and the North American species *X. ajoensis* (Nash) Hale. *X. ajoensis* is clearly distinguished, however, by its pale lower surface, while the distinguishing features of *X. vicaria* are detailed below under that species.

X. nashii appears to be very rare, and at present is known from only two locations.

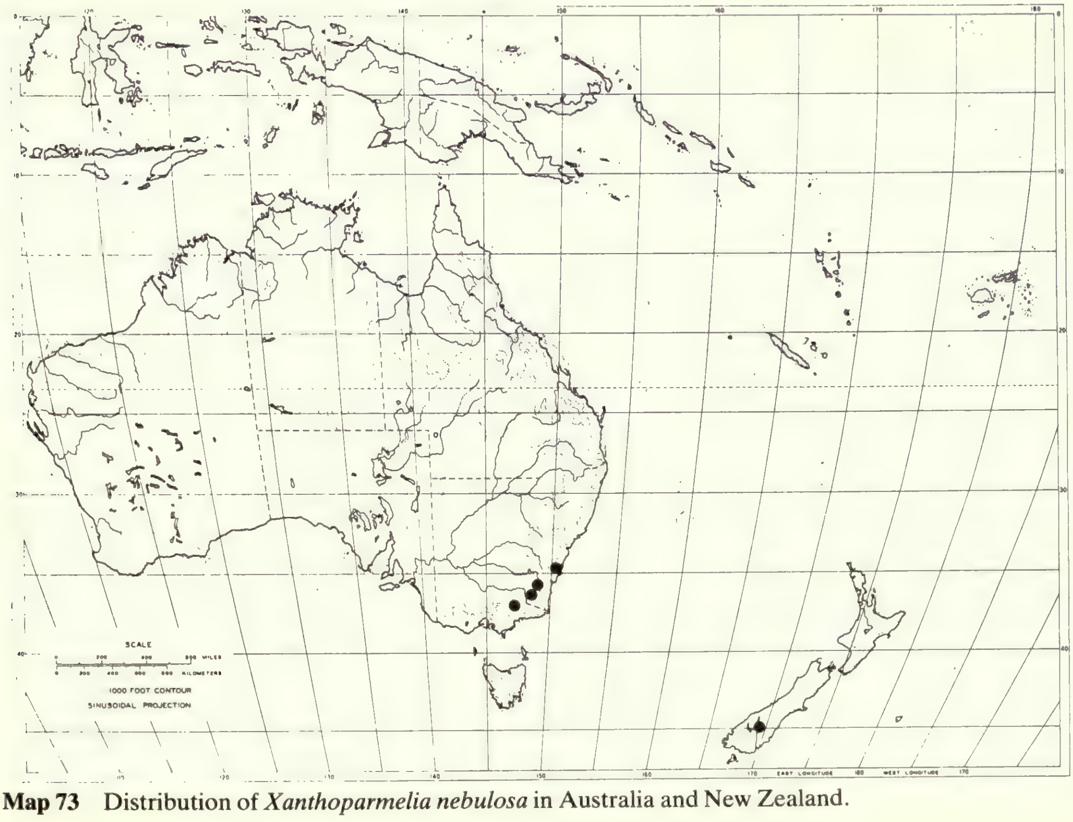
The species is named in honour of the American lichenologist, Professor T. H. Nash.

73. **Xanthoparmelia nebulosa** (Kurok. & Filson) Elix & Jen Johnston, **comb. nov.**

Basionym: *Parmelia nebulosa* Kurok. & Filson in Filson in *Aust. J. Bot.* **30**: 547 (1982). Type: Australia, Australian Capital Territory, on summit of Mount Coree, *c.* 1390 m., *S. Kurokawa* 6350 (TNS – holotype; ANUC! – isotype).

Illustration: Filson (op. cit.).

DESCRIPTION. *Thallus* foliose, moderately to loosely adnate on rocks, yellow green, sometimes becoming deep olive-green or blackening with age, 6–10 cm diam.; *lobes* subirregular, strongly imbricate, contiguous or not, 1–2·5(–5·0) mm wide, apices crenulate, ± rotund; secondary lobes narrower, to 1·0 mm wide, imbricate and entangled, sometimes overgrowing marginal lobes. *Upper surface* shiny, emaculate, becoming rugose and cracked with age, lacking soredia and isidia but with numerous pycnidia, often black-margined particularly towards the lobe apices;



Map 73 Distribution of *Xanthoparmelia nebulosa* in Australia and New Zealand.

medulla white. *Lower surface* pale ivory to brown, moderately rhizinate, rhizines yellow-brown to brown, simple, slender. *Apothecia* adnate or short stipitate, 2–7 mm diam.; disc concave, dark brown, margin involute at first, later becoming undulating and developing irregular cracks; spores 8·5–12 × 5–7 μm.

CHEMISTRY. Thallus K−; medulla K−, C−, KC−, P−; containing usnic acid, and traces of dehydroconstipatic acid, pertusaric acid, constipatic acid, protoconstipatic acid, and larger quantities of an unidentified aliphatic acid.

DISTRIBUTION. South-eastern Australia (NSW, ACT, Vic) and South Island, New Zealand (Mackenzie Country). Map 73. On exposed rocks in subalpine and alpine areas. Specimens examined: 7.

NOTES. Morphologically this species resembles adnate specimens of *Xanthoparmelia flavescentireagens* and *X. taractica* in that all three species have similar thalli, densely imbricate lobes with rotund apices, and a pale lower surface. However, *X. taractica* differs in being more densely rhizinate and producing salazinic acid in the medulla, while *X. flavescentireagens* often has elongated, subdichotomously-divided secondary lobes, a feature which is not observed in *X. nebulosa*. Furthermore, *X. flavescentireagens* invariably produces loxodin and norlobaridone in the medulla (KC+ rose), while *X. nebulosa* produces only usnic acid and several aliphatic acids. In morphology this species also resembles *X. bungendorensis*, but in the latter the lobes are only loosely imbricate (not mat-forming) and the medulla contains scabrosin metabolites.

X. nebulosa may also be confused with *X. spargenosa* since both species have a pale lower surface, similar thallus morphology, and negative chemical reactions. The distinguishing features of *X. spargens* are discussed below under that species.

X. nebulosa is a rare species on alpine and subalpine rocks where it is found growing together with *X. metaclystoides, X. tasmanica, X. cordillerana, X. scabrosa, X. flavescentireagens,* and *Hypogymnia tubularis* (Taylor) Elix (in Australia).

74. **Xanthoparmelia neorimalis** (Elix & P. Armstr.) Elix & T. Nash

in *Mycotaxon* **26**: 455 (1986).

≡ *Parmelia neorimalis* Elix & P. Armstr. in *Aust. J. Bot.* **31**: 475 (1983). Type: Australia, Australian Capital Territory, Black Mountain Reserve, on quartzite rocks along trail to other peak, 640 m, 8 July 1979, *J. A. Elix* 6124 (MEL! – holotype).

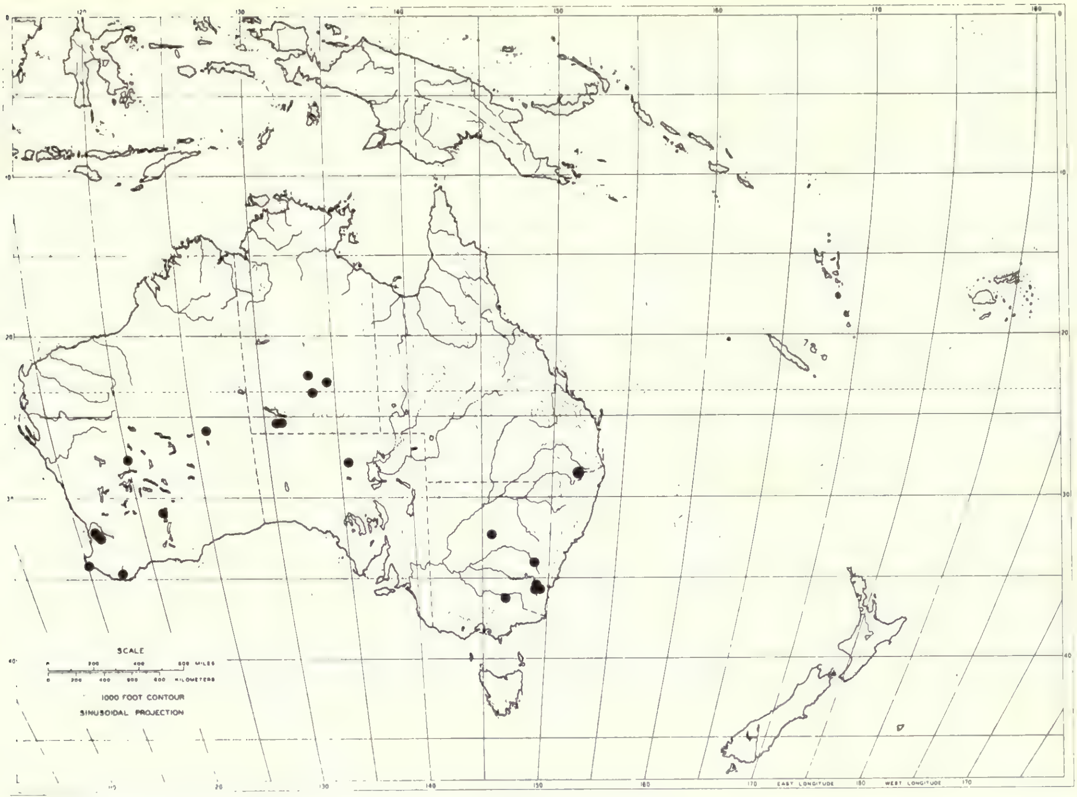
Illustration: Elix & Armstrong (op. cit.).

DESCRIPTION. *Thallus* subcrustose to small-foliose, tightly adnate on rocks, greenish-yellow, darkening with age, ± forming small rosettes, linear-elongate to subirregularly lobate and becoming almost subcrustose centrally, 3–6 cm diam.; *lobes* sublinear-elongate, contiguous or ± radiating at periphery, 0·3–0·6(–0·8) mm wide, not at all imbricate, older lobes irregularly fractured and areolae commonly formed. *Upper surface* flat to slightly convex, opaque, emaculate, often tangentially cracked, lacking soredia and isidia; medulla white. *Lower surface* tan to brown but often straw-yellow near lobe apices, moderately rhizinate, the rhizines short, simple, pale brown. *Apothecia* adnate, 0·5–1·0 mm diam., disc dark brown, exciple smooth, margin narrow, ± crenulate; spores 7–9 × 3·5–5·0 μm.

CHEMISTRY. Thallus K−; medulla K+ yellow then red, C−, KC−, P+ yellow-orange; containing usnic acid, salazinic acid, consalazinic acid.

DISTRIBUTION. Australia (Qld, NSW, ACT, Vic, SA, NT, WA). Map 74. Known also from Mexico. On rocks in arid, subarid, and areas of moderate rainfall. Specimens examined: 42.

NOTES. This species belongs to the *X. dubitata* group characterised by diminutive, tightly adnate, ± subcrustose thalli with a pale lower surface and the development of areolae in older parts of the thallus. A key to this group is given under *X. dubitata*. *X. neorimalis* is very similar to *X. oleosa* since both develop tightly adnate rosettes with sublinear-elongate, contiguous lobes. These species are readily differentiated chemically since *X. neorimalis* contains salazinic acid



Map 74 Distribution of *Xanthoparmelia neorimalis* in Australia.

(K+ yellow-red) but *X. oleosa* contains the aliphatic acids, constipatic acid, dehydroconstipatic acid, and related compounds (K−).

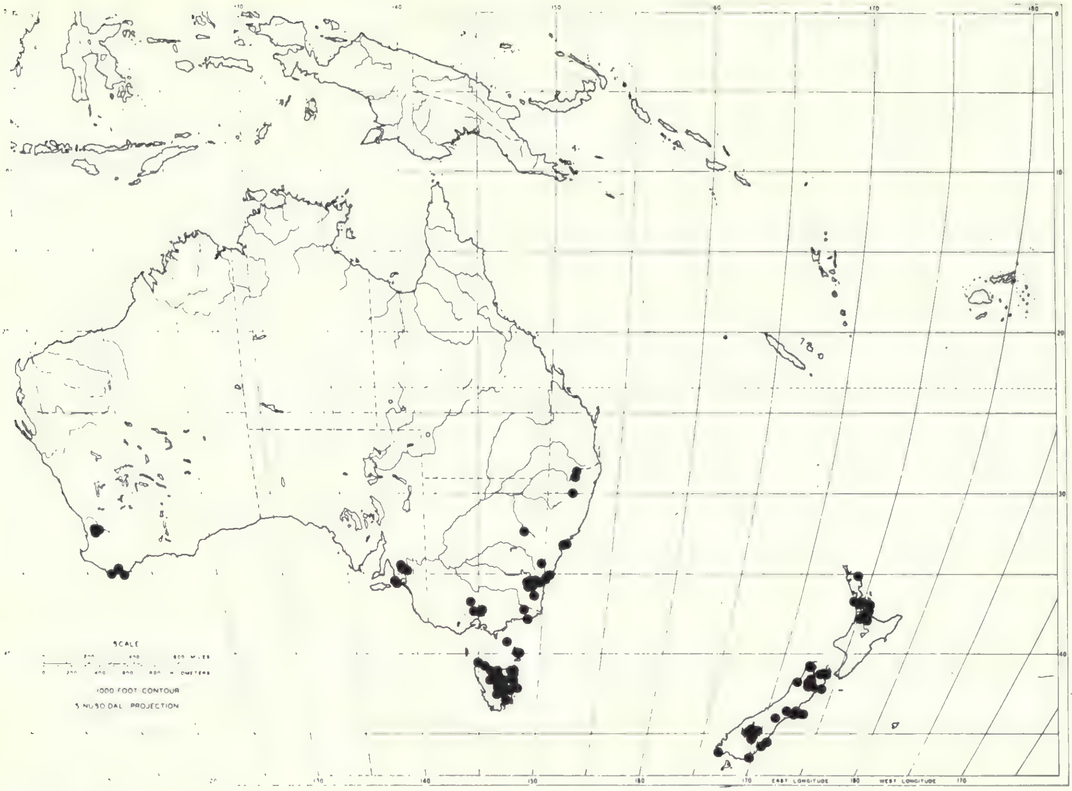
Chemically this species is identical with *X. lineola*, which also has adnate lobes and a pale lower surface. However the thallus of *X. lineola* is much larger, (5–10 cm in diameter cf. 3–6 cm), with broader (1–5 mm wide cf. 0·3–0·6 mm wide), thicker lobes, commonly with rotund apices.

X. neorimalis is a diminutive, tightly adnate lichen which, although widespread, is often overlooked. In eastern Australia it often occurs with *X. filarszkyana* and *X. mougeotina*, while in more arid areas common associates include *X. cravenii, X. pertinax, X. amplexula*, and *X. australasica*.

75. **Xanthoparmelia neotinctina** (Elix) Elix & Jen Johnston, **comb. nov.**

Basionym: *Parmelia neotinctina* Elix in *Aust. J. Bot.* **29**: 363 (1981). Type: Australia, Victoria, 1 km north of Tallarook, on rocks in dry sclerophyll forest, *J. A. Elix* 4856 (MEL! – holotype; CBG! – isotype).
Illustration: Elix (op. cit.).

DESCRIPTION. *Thallus* foliose, adnate on rocks, yellow-green to deep olive-green, sometimes blackening with age, irregularly lobate, 5–8(–12) cm diam.; *lobes* linear-elongate to subirregular, imbricate, 1·5–4·0(–8·0) mm wide, apices elongated or crenate and subrotund. *Upper surface* shiny at first, emaculate, often black-margined, usually developing dense isidia, *isidia* cylindrical at first, usually becoming highly branched and coralloid, often forming a dense isidiose mat, the isidia commonly black tipped; medulla white. *Lower surface* black fading to black-brown or brown at apices of marginal lobes, sparsely rhizinate, rhizines simple, concolorous with lower surface. *Apothecia* adnate, 2–4(–7) mm diam., disc brown to dark brown, exciple and margin isidiate; spores 7–9 × 4·5–7 μm.



Map 75 Distribution of *Xanthoparmelia neotinctina* in Australia and New Zealand.

Chemistry. Thallus K−; medulla K+ yellow then red, C−, KC−, P+ intense yellow; containing usnic acid, norstictic acid (major), salazinic acid (±), connorstictic acid (±).

Distribution. Widely distributed in southern and eastern Australia (Qld, NSW, ACT, Vic, Tas, SA, WA) and New Zealand. Map 75. On rocks in coastal, mountain, and subalpine habitats. Specimens examined: 192.

Notes: This broad-lobed species resembles *X. isidiigera* in overall growth habit, the presence of isidia, and the black lower surface. However isidia in *X. isidiigera* are commonly sparse and simple while *X. neotinctina* has dense isidia which exhibit complex branching and often become coralloid, forming a dense, isidiose mat above the surface of the thallus. As the isidia often have blackened apices, the isidiose areas of the thallus generally appear much darker in colour (deep olive-green) in comparison with the more sparsely isidiate marginal lobes. This species also differs from *X. isidiigera* in that thalli are more loosely adnate and contain norstictic acid as a major metabolite in addition to usnic acid and salazinic acid. *X. isidiigera* contains usnic acid, salazinic acid, and occasionally traces of norstictic acid as an accessory metabolite.

X. neotinctina exhibits considerable variation in lobe configuration. Generally lobes are narrow (2–3 mm wide) and sublinear-elongate, but occasionally they may be much broader (5–8 mm wide) with subrotund apices. It resembles *X. australasica*, but that species contains only usnic and salazinic acids. For further comparisons refer to discussion under *X. australasica*.

X. neotinctina is a common species in more temperate areas of southern Australia and New Zealand and favours rocks in open situations, where it is often associated with *X. tasmanica, X. congesta, X. notata, X. amplexula*, and *X. flavescentireagens*.

76. Xanthoparmelia norconvoluta (Elix & P. Armstr.) Elix & Jen Johnston, **comb. nov.**

Basionym: *Parmelia norconvoluta* Elix & P. Armstr. in *Aust. J. Bot.* **31**: 477 (1983). Type: Australia, Victoria, Thurla, *c.* 10 km west of Red Cliffs, growing on soil among stunted mallee, September 1940, *J. H. Willis* (MEL 34648! – holotype).

Illustration: Elix & Armstrong (op. cit.).

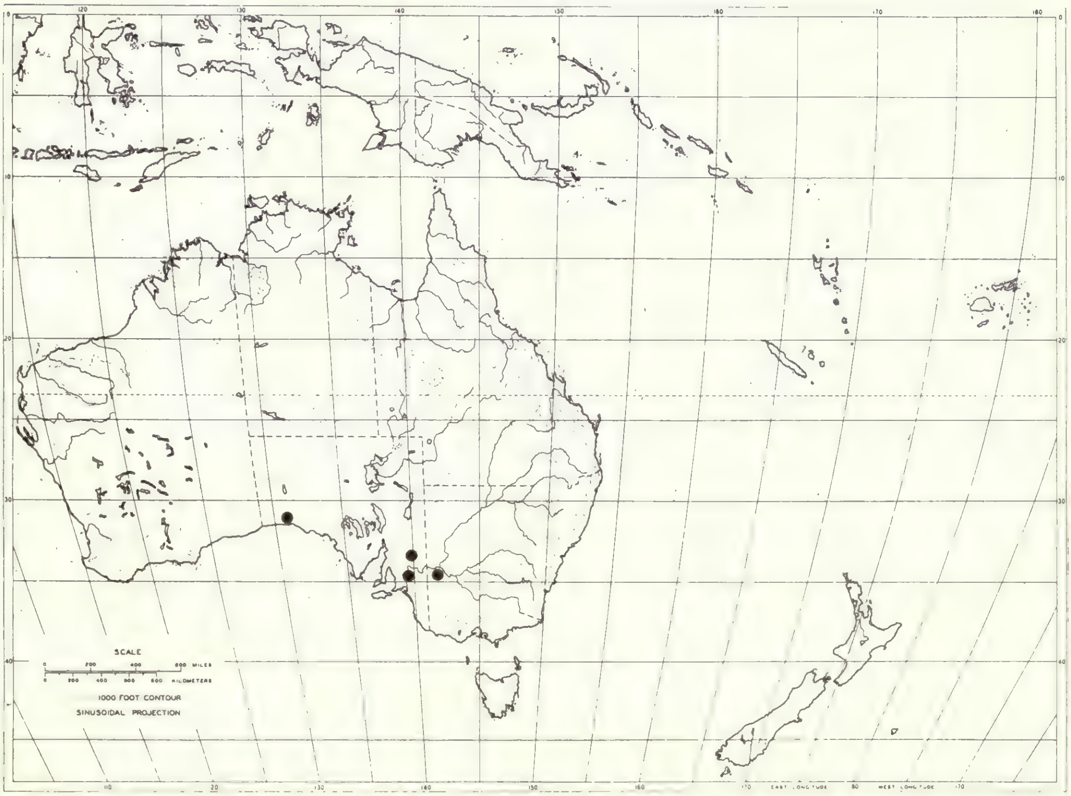
DESCRIPTION. *Thallus* foliose, unattached on soil, pale yellow-green, darkening in older, central lobes, 2–6 cm diam.; *lobes* elongate, convolute, contorted, 3·5–8·0 mm broad when flattened but 1·0–4·0 mm when dry and convoluted. *Upper surface* smooth, emaculate, becoming rugulose and cracked in older lobes, soredia and isidia absent, marginal and laminal lobules sometimes present in older lobes. *Lower surface* pale to dark brown, very sparsely rhizinate, rhizines simple, concolorous with lower surface. *Apothecia* not seen.

CHEMISTRY. Thallus K−; medulla K+ yellow-red brown, C−, P+ orange; containing usnic acid, norstictic acid, and connorstictic acid.

DISTRIBUTION. Nullarbor Plain, Murray mallee (Vic, SA). Map 76. On soil in mallee scrub and arid shrubland. Specimens examined: 6.

NOTES. This species, with the characteristic convolute, highly contorted lobes, closely resembles *X. australiensis* and *X. convoluta* and is only reliably distinguished from them by chemical means. For further discussion see under *X. australiensis*.

X. norconvoluta has a scattered distribution occurring on soil in subarid and arid areas where common associates include *Psora decipiens* (Hedwig) Hoffm., *Diploschistes scruposus* (Schreber) Norman, *Chondropsis semiviridis* (Nyl.) Nyl., *Xanthoparmelia reptans*, *X. subdistorta*, and *X. norpumila*.



Map 76 Distribution of *Xanthoparmelia norconvoluta* in Australia.

77. **Xanthoparmelia norpumila** Elix & Jen Johnston, **sp. nov.**

Thallus ut in *Xanthoparmelia pumila* sed acidum norsticticum et acidum connorsticticum continenti differt. Thallus 175–200 μm crassus; cortex superior 14–20 μm crassus, stratum gonidiale 15–30 μm crassum, medulla 120–150 μm crassa, cortex inferior 7–10 μm crassus. Thallus K−; medulla K+ primum flavens deinde rubescens, C−, P+ intense lutescens.

Type: Australia, Western Australia, Eyre, on soil near abandoned Burnabbie Homestead, under scarp of Hampton Range, 22 May 1981, *D. L. Serventy* (MEL 1033156! – holotype).
Illustration: Fig. 30.

Description. *Thallus* foliose, adnate, terricolous, bright to pale yellow, often whitish-yellow at lobe apices, irregularly lobate, 3–10 cm diam.; *lobes* ± concave, not at all ascending, 0·7–1·5 mm wide, often lobulate, lobules branched, ascending, subterete to cylindrical, often blackened at apices, 0·2–0·4 mm diam. *Upper surface* opaque, emaculate, ± rugulose; medulla white. *Lower surface* canaliculate or not, black but becoming brown to yellow near apices of marginal lobes, sparsely to moderately rhizinate, rhizines simple, slender, black, 0·2–0·4 mm long. *Apothecia* rare, to 3 mm diam., disc flat to slightly concave, dark brown, margin thick, prominent, crenulate becoming incised; spores 10–11 × 5–6 μm.

Chemistry. Thallus K−; medulla K+ yellow-red brown, C−, P+ yellow-orange; containing usnic acid, norstictic acid, and connorstictic acid.

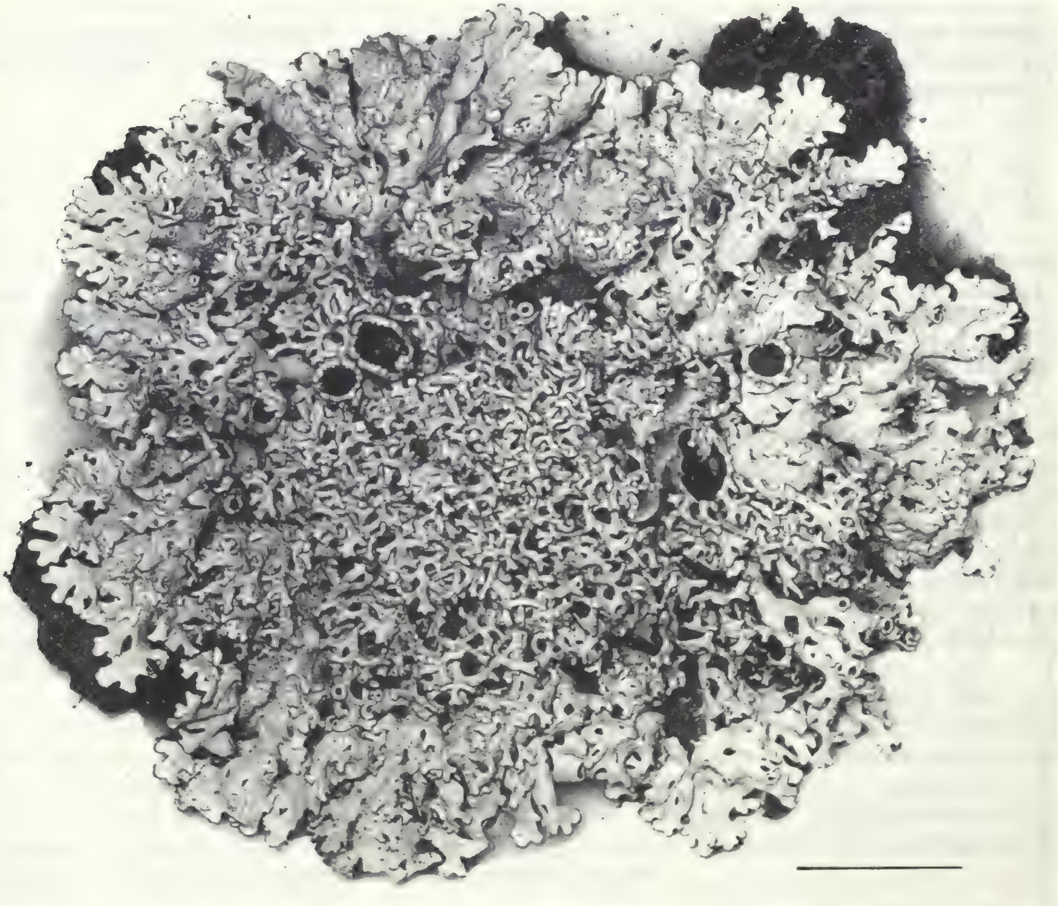
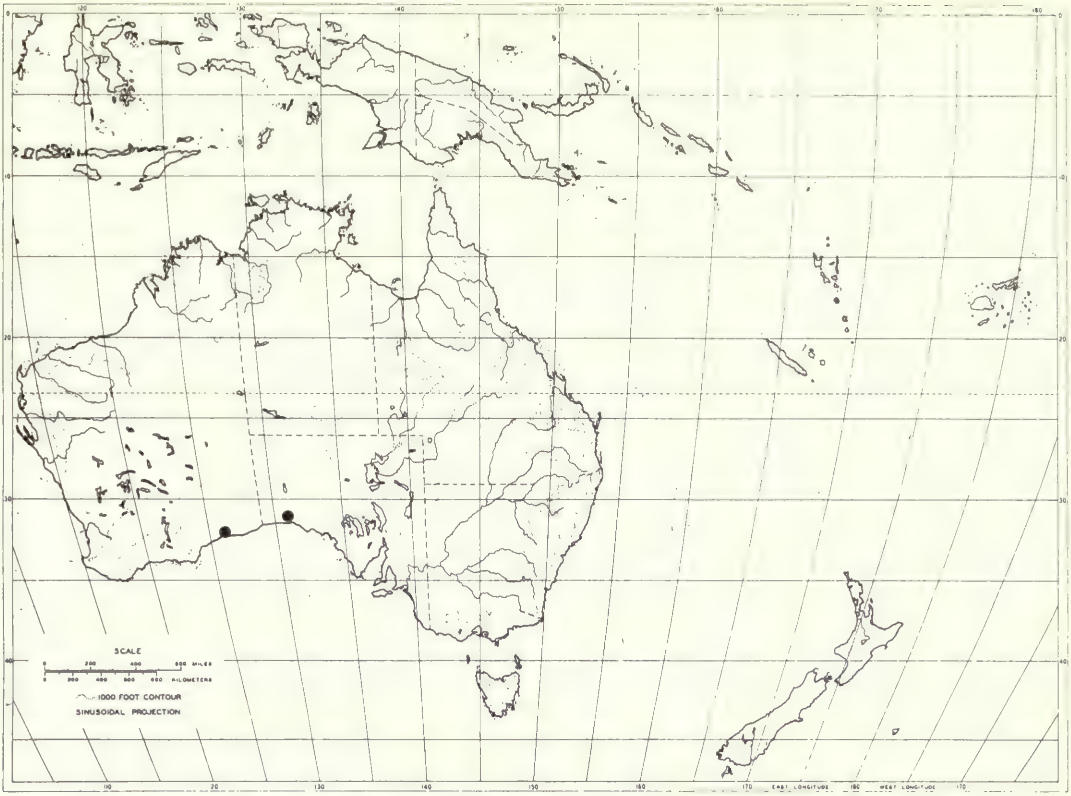


Fig. 30 *Xanthoparmelia norpumila* Elix & Jen Johnston. *Elix* 2309 in ANUC. Scale = 1 cm.



Map 77 Distribution of *Xanthoparmelia norpumila* in Australia.

DISTRIBUTION. Nullarbor Region (SA, WA). Map 77. On soil in arid shrubland. Specimens examined: 2.

NOTES. This distinctive terricolous species has an unusual combination of characters: a black lower surface, development of terete lobules centrally, and a white pruinose zone on the upper surface near the apices. It appears to be morphologically indistinguishable from *X. pumila* and can be separated only by chemical means. Thus *X. pumila* contains salazinic acid in the medulla rather than norstictic acid and connorstictic acid.

X. pumila is distributed much more widely than *X. norpumila* (Maps 77, 86) and, since they appear to maintain their chemical integrity (no chemical combinants observed), they are maintained here as separate species.

This species belongs to the *X. versicolor* group and a key is presented under *X. versicolor*.

X. norpumila is a rare, widely dispersed species occurring on soil in subarid and arid areas where common associates include *Psora decipiens* (Hedwig) Hoffm., *Diploschistes scruposus* (Schreber) Norman, *Chondropsis semiviridis* (Nyl.) Nyl., *Xanthoparmelia reptans, X. subdistorta*, and *X. norconvoluta*.

78. **Xanthoparmelia notata** (Kurok.) Hale

in *Phytologia* **28**: 488 (1974).

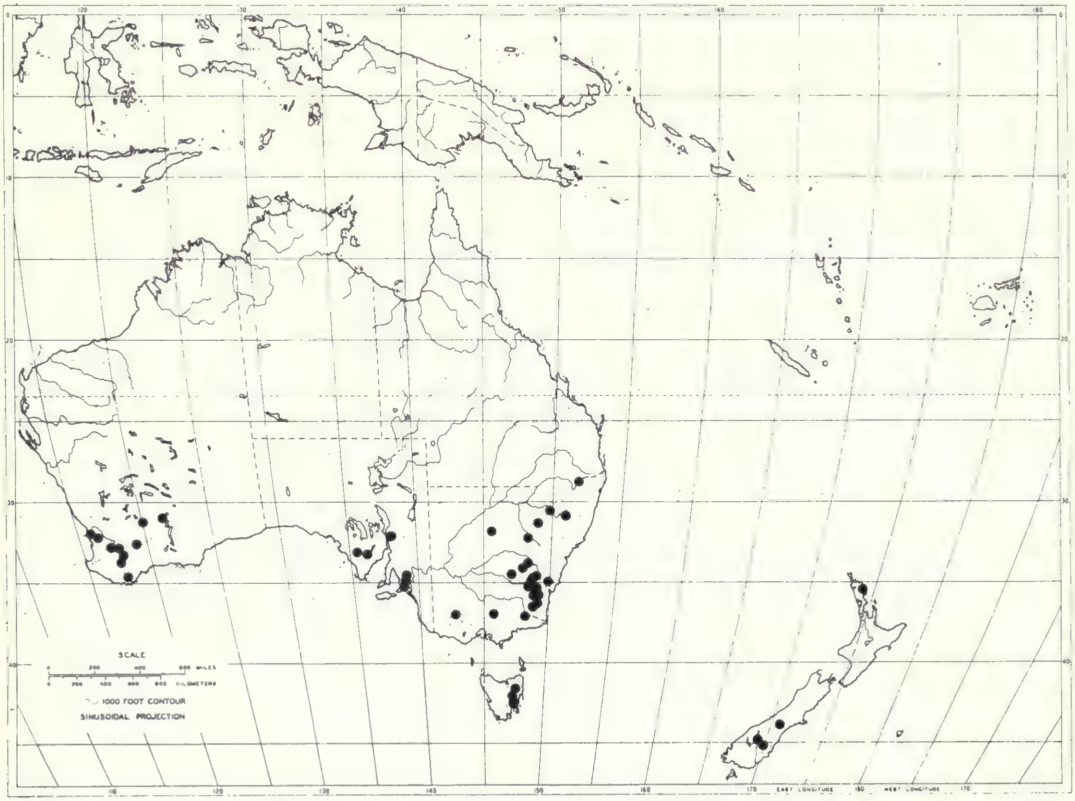
≡ *Parmelia notata* Kurok. in Kurokawa, Elix, Watson & Sargent in *J. Jap. Bot.* **46**: 33 (1971). Type: Australia, New South Wales, sandstone escarpment on the road 8 km east of Nerriga, on rock, *c.* 750 m, *S. Kurokawa* 6401 (TNS – holotype; MEL! – 1013467 isotype).

Illustrations: Kurokawa et al. (op. cit.); Galloway in *NZ. Jl. Bot.* **18**: 541 (1981).

DESCRIPTION. *Thallus* foliose, loosely adnate to adnate, saxicolous, yellow-green, 6–14 cm diam.; *lobes* irregular to sublinear-elongate, di- or trichotomously branched, commonly imbricate, lobe apices ascending or not, 0·7–2·0 mm wide. *Upper surface* with distinct effigurate maculae, the margin commonly brown or black, lacking soredia and isidia; medulla white. *Lower surface* black, rugulose or not, with sparse simple rhizines, rhizines black, 0·5–1·2 mm long. *Apothecia* sessile, 4–10 mm diam., disc dark brown, often with radiating fissures, exciple with effigurate maculae; spores 6–8 × 3–4 μm.

CHEMISTRY. Thallus K−; medulla K−, C−, KC−, P−; containing usnic acid, 4-*0*-methylhypoprotocetraric acid, notatic acid, and traces of hypoprotocetraric acid (±), isonotatic acid (±), subnotatic acid (±), 4-*0*-demethylnotatic acid (±).

DISTRIBUTION. This species is common throughout southern and eastern Australia (Qld, NSW, ACT, Vic, Tas, SA, WA) and also occurs in New Zealand. Map 78. On rocks in lowland, mountain, and subalpine habitats. Specimens examined: 132.



Map 78 Distribution of *Xanthoparmelia notata* in Australia and New Zealand.

NOTES. This species belongs to the *X. hypoleia* group which is characterised by effigurate maculae on the upper surface, and a black, sparsely rhizinate, lower surface. A key to this group is given under *X. hypoleia*, where the taxonomic status of the chemical races is discussed.

Like the closely related species, *X. hypoprotocetrarica*, this species has a variable morphology. Some specimens have short, broad lobes with subrotund apices, while others may be dominated by sublinear, almost divaricate lobes. To some extent these two species appear to have intergrading morphologies and the only completely reliable distinguishing feature is their distinctive chemistries. Even so, *X. hypoprotocetrarica* often has lobes which are subascending at the apices, whereas in *X. notata* they are flat. The lobes of *X. notata* are also usually a brighter yellow-green.

X. notata is a common species in more temperate areas of southern Australia but is rare in New Zealand. It favours rocks in open situations and is often found together with *Cladia aggregata* (Swartz) Nyl., *Parmelia signifera* Nyl., *Xanthoparmelia tasmanica, X. australasica, X. hypoprotocetrarica, X. neotinctina,* and *X. glareosa*.

79. **Xanthoparmelia oleosa** (Elix & P. Armstr.) Elix & T. Nash

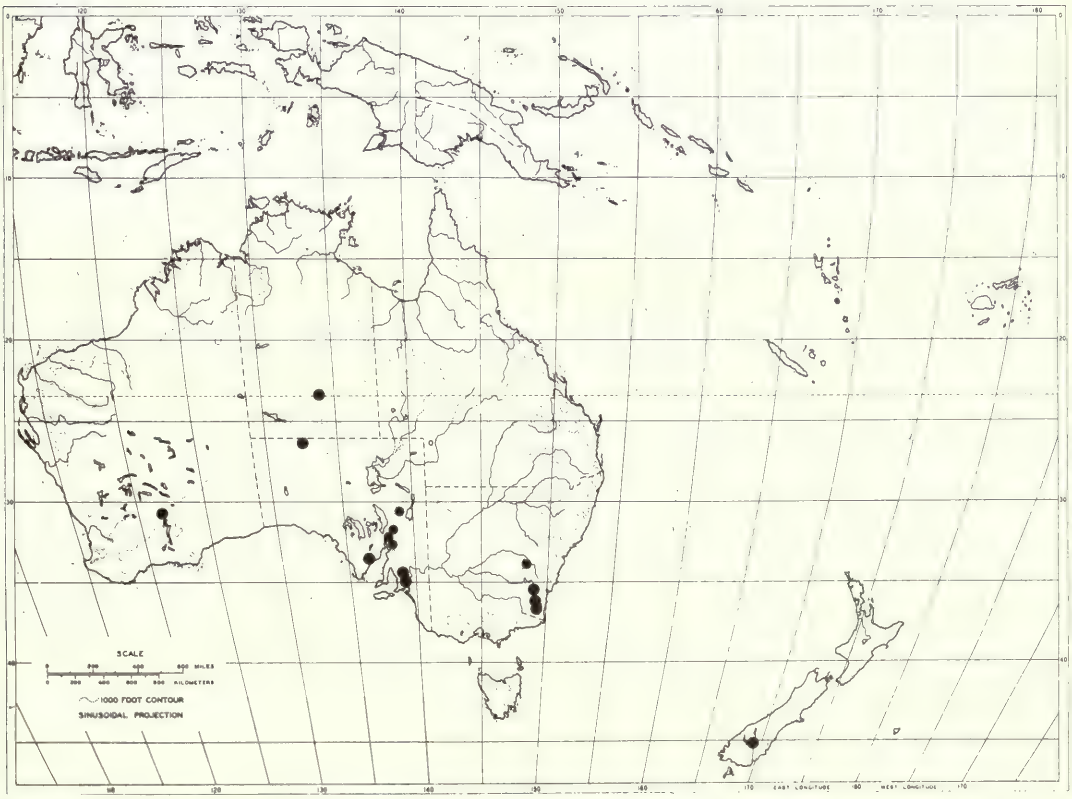
in *Mycotaxon* **26**: 455 (1986).

≡ *Parmelia oleosa* Elix & P. Armstr. in *Aust. J. Bot.* **31**: 478 (1983). Type: Australia, New South Wales, along the Tuross River, 13 km south of Countegany, growing on rocks, 1030 m, 24 September 1979, *J. A. Elix* 6397 (MEL! – holotype).

Illustration: Elix & Armstrong (op. cit.).

DESCRIPTION. *Thallus* small-foliose, tightly adnate on rocks, yellow-green, darkening with age, and becoming greyish-black, often becoming subcrustose centrally, 3–6 cm diam.; *lobes* sublinear-elongate to subirregular, barely imbricate, older lobes extensively fractured and areolae formed, lobes 0·8–1·5(–2·0) mm wide and areolae *c.* 1·0 mm diam. *Upper surface* opaque or shiny towards periphery, emaculate, often tangentially cracked, commonly black-margined, particularly towards lobe apices, lacking soredia and isidia; medulla white. *Lower surface* tan to dark brown, often somewhat darker to smoke-grey near lobe apices, moderately rhizinate, rhizines brown, simple. *Apothecia* adnate to substipitate, 1·0–2·0(–4·0) mm diam., margin thin, entire, disc concave, dark brown, exciple smooth; spores 7–8 × 3·5–4·5 μm.

CHEMISTRY. Thallus K−; medulla K−, C−, KC−, P−; containing usnic acid, protoconstipatic acid, constipatic acid, dehydroconstipatic acid, pertusaric acid.


120
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1000 FOOT CONTOUR
SINUSOIDAL PROJECTION
110
120
130
140
150
160
170
EAST LONGITUDE
180
WEST LONGITUDE
170

Map 79 Distribution of *Xanthoparmelia oleosa* in Australia and New Zealand.

DISTRIBUTION. Southern and central Australia (NSW, ACT, SA, WA, NT), South Island, New Zealand (Central Otago). Map 79. Also known from Arizona (U.S.A.), and Mexico. Rare. On rocks in drier upland, subarid, and arid areas. Specimens examined: 31.

NOTES. This species belongs to the *X. dubitata* group which is characterised by tightly adnate, diminutive, ± subcrutose thalli, which often form areolae in the older parts, and which also have a brown lower surface. *X. oleosa* has sublinear-elongate lobes and, in this respect, closely resembles *X. neorimalis* and *X. cravenii*, but the lobes of *X. oleosa* tend to be rather broader (0·8–1·5 mm wide cf. 0·3–0·6 mm) than those of *X. neorimalis*. Further *X. oleosa* is chemically quite distinct since it contains usnic acid, together with the aliphatic acids dehydroconstipatic acid, pertusaric acid, constipatic acid and protoconstipatic acid, while *X. neorimalis* contains salazinic acid, and *X. cravenii* contains scabrosin derivatives and constipatic (±) and protoconstipatic (±) acids.

Chemically this species resembles *X. ustulata* but this species has much broader lobes that are moderately adnate to the substrate and commonly suberect at the apices, and with an ivory to pale brown lower surface. The tightly adnate lobes of *X. oleosa* are flat at the apices, narrow (0·8–1·5 mm wide cf. 1·5–4 mm), and the lower surface is brown to dark brown, but on rare occasions these two species may be difficult to distinguish. *X. oleosa* also resembles the African–North American species *X. subdecipiens* (Vainio) Hale, which has tightly adnate lobes, but which are thicker, broader (1·5–5·0 mm) and marginally rotund, while the medulla contains a more extensive array of aliphatic acids (at least eight) than does *X. oleosa*. *X. oleosa* most closely resembles *X. cravenii*. The distinguishing features of these species are discussed under the latter.

X. oleosa has a scattered distribution in drier areas. Associates include *Acarospora schleicheri* (Ach.) Massal., *Buellia* sp., *Xanthoparmelia neorimalis, X. filarszkyana, X. lineola,* and *X. subcrustacea.*

80. Xanthoparmelia parvoincerta Elix & Jen Johnston, sp. nov.

Thallus ut in *Xanthoparmelia neorimalis* sed superficie nigra differt. Thallus adpressus, plus minusve versus centrum hujus fere subcrustosus. Thallus 300–360 μm crassus, cortex superior 50–80 μm crassus, stratum gonidiale 14–60 μm crassum, medulla 210–280 μm crassa, cortex inferior 7–14 μm crassus. Thallus K−; medulla K+ primum flavens deinde rubescens, C−, P+ intense lutescens; acidum usnicum et acidum salazinicum et acidum consalazinicum et plus minusve atranorinum et acidum constipaticum et acidum protoconstipaticum continens.

Type: Australia, Western Australia, Porongurup Range, northern slopes of Angwin Peak, on exposed granite rocks, 400 m, 23 October 1982, *J. A. Elix* 10648 & *L. H. Elix* (CBG! – holotype).
Illustration: Fig. 31.

DESCRIPTION. *Thallus* small-foliose to subcrustose, adnate to tightly adnate on rocks, yellow-green, darkening with age, 2–4 cm diam.; *lobes* radiating at periphery or rarely contiguous, sublinear-elongate, dichotomously to subirregularly divided, imbricate or not, 0·5–1·0(–1·5) mm wide, older lobes tangentially fractured and areolae commonly formed, central lobes eventually eroding. *Upper surface* shiny, emaculate but becoming dull and eventually developing tangential cracks, margin distinctly blackened, lacking soredia and isidia; medulla white. *Lower surface* black, sparsely to moderately rhizinate, rhizines simple, robust, black. *Apothecia* substipitate, rare, *c.* 1·0 mm diam., concave, disc dark brown, shiny, margin entire, thick, exciple smooth; spores 8 × 5·0–5·5 μm.

CHEMISTRY. Thallus K−; medulla K+ yellow becoming red, C−, P+ intense yellow; containing usnic acid, salazinic acid, consalazinic acid and accessory atranorin (±), protoconstipatic acid (±), and constipatic acid (±).

DISTRIBUTION. Western and central Australia (WA, NT). Map 80. Rare. On rocks in coastal, hinterland, subarid, and arid areas. Specimens examined: 7.

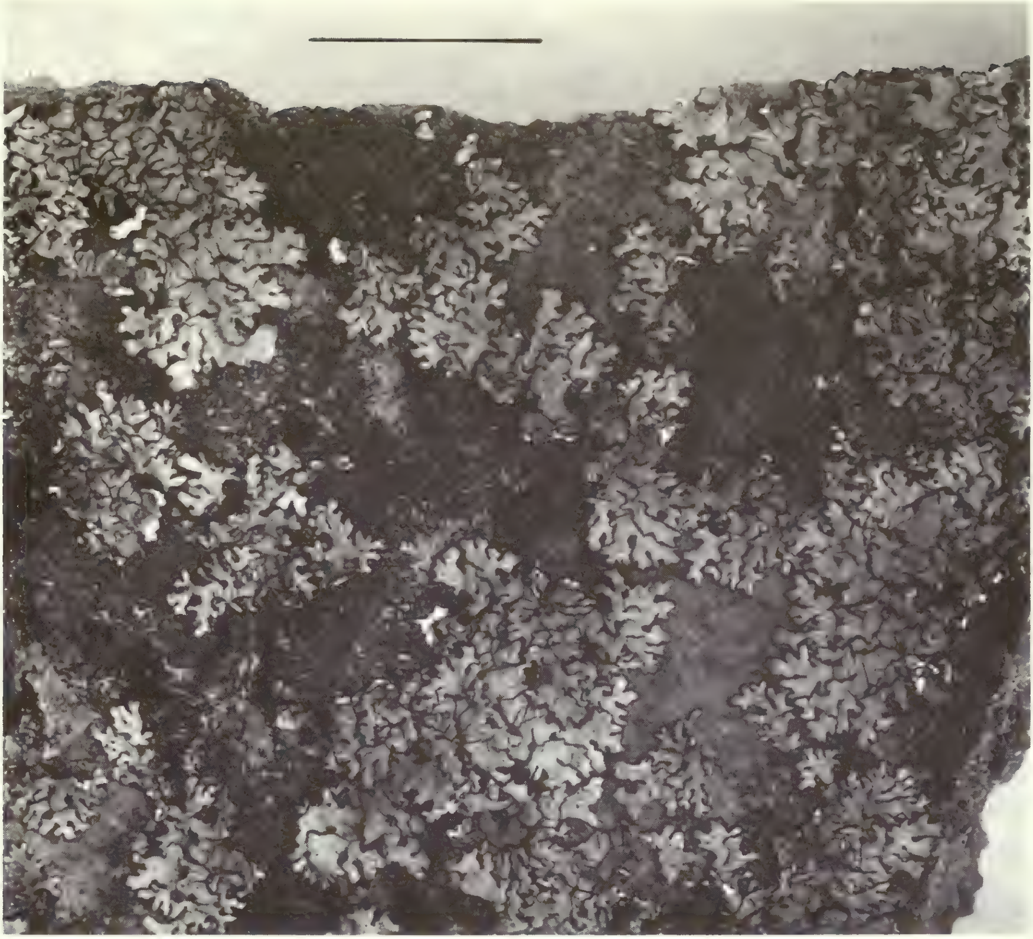


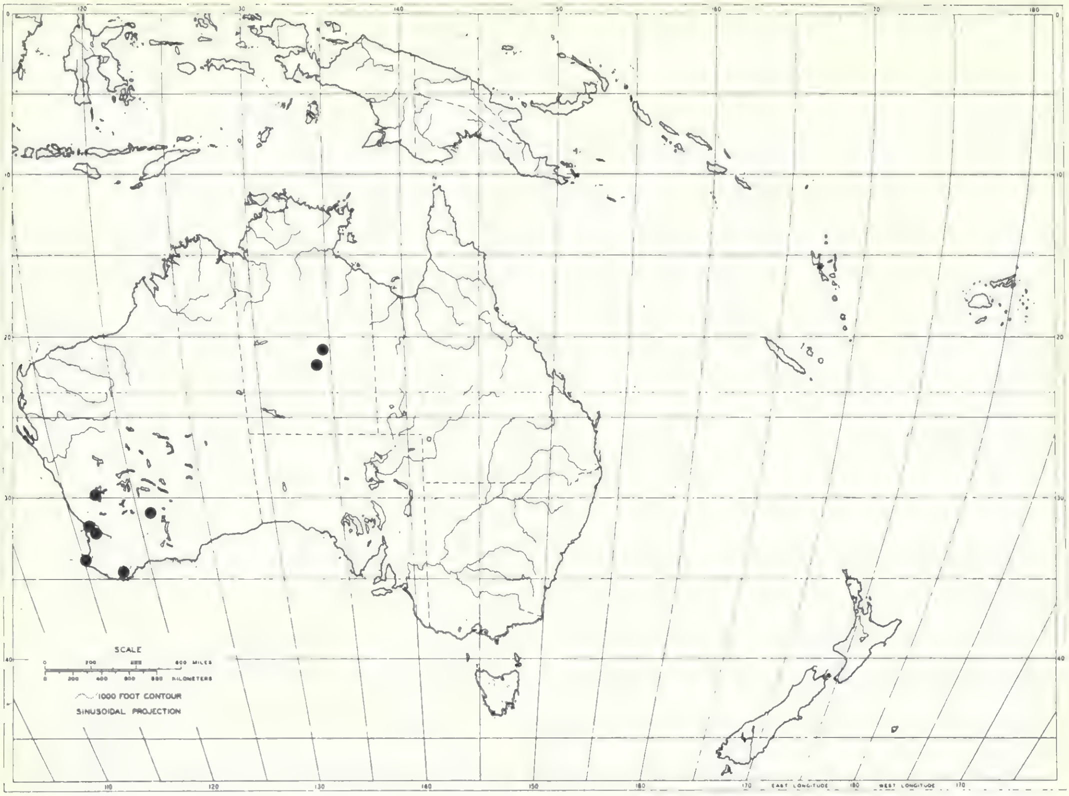
Fig. 31 *Xanthoparmelia parvoincerta* Elix & Jen Johnston. Portion of holotype in CBG. Scale = 1 cm.

NOTES. This species resembles *Xanthoparmelia neorimalis* in lobe configuration and the production of salazinic acid in the medulla, but *X. neorimalis* has a pale lower surface and its lobes are often contiguous, while *X. parvoincerta* has a black lower surface and typically, stellate lobes.

Morphologically *X. parvoincerta* also resembles *X. dissitifolia* since both species commonly have linear-elongate, tightly adnate, radiating lobes with a black lower surface. However, lobes in *X. parvoincerta* are somewhat broader (0·5–1·0 mm) than those of *X. dissitifolia* (0·3–0·7 mm), and are often imbricate, while lobes of *X. dissitifolia* tend to be more linear-elongate and are rarely imbricate. Furthermore, *X. dissitifolia* contains norstictic acid, connorstictic acid, and ± traces of salazinic acid in the medulla, but *X. parvoincerta* contains salazinic acid and consalazinic acid.

Chemically this species is identical with *X. incerta*, another species with a dark brown to black lower surface. However *X. incerta* has much broader (1·0–3·0 mm wide), irregular lobes dissimilar from the narrow (0·5–1·0 mm wide), dichotomously to subdichotomously divided lobes of *X. parvoincerta*.

X. parvoincerta is a scattered and rather rare (or at least seldom-collected) species on exposed rocks. Associates are *X. australasica, X. lineola, X. neorimalis, X. scabrosa, X. substrigosa,* and *X. isidiigera*.



Map 80 Distribution of *Xanthoparmelia parvoincerta* in Australia.

81. **Xanthoparmelia pertinax** (Kurok. & Filson) Elix & Jen Johnston, **comb. nov.**

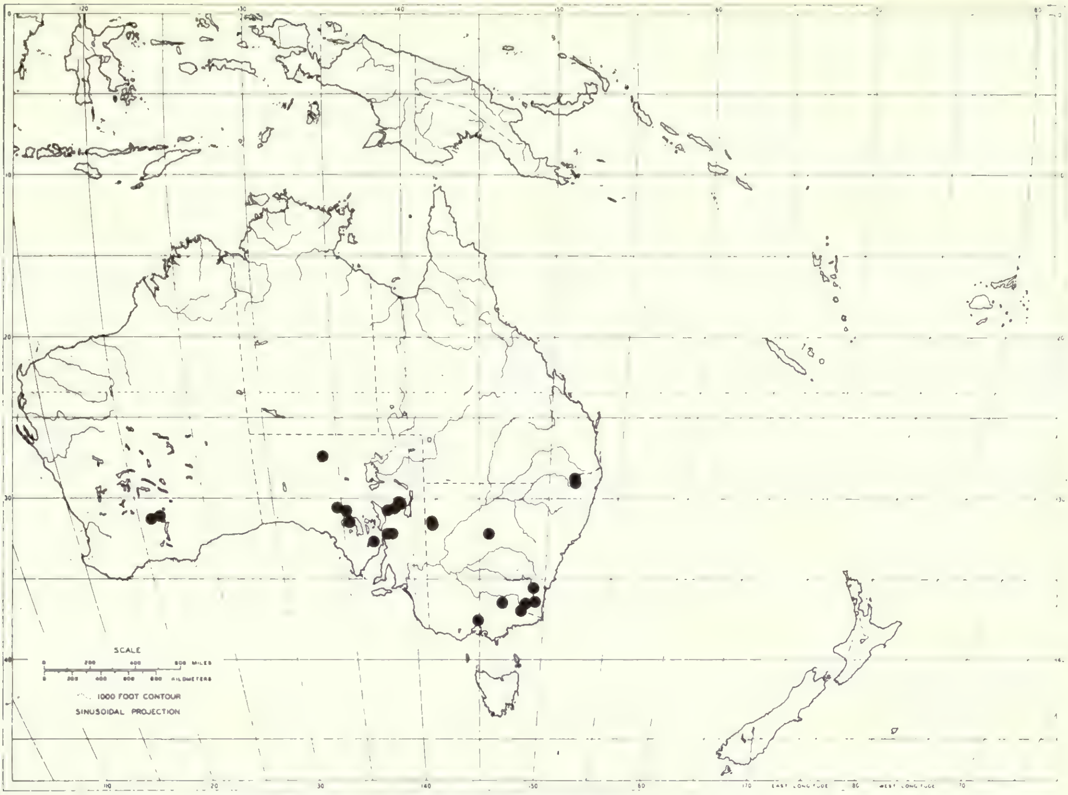
Basionym: *Parmelia pertinax* Kurok. & Filson in *Bull. natn. Sci. Mus. Tokyo* B, **1**: 41 (1975). Type: Australia, South Australia, Eyre Peninsula, growing on large granite slabs on hill to south of old dam on western side of Corunna Range, *R. Filson* 11728 (MEL 1011843! – holotype).
Illustration: Kurokawa & Filson (op. cit.).

DESCRIPTION. *Thallus* foliose to subcrustose, adnate to tightly adnate, pale yellow-green to olive-green, darkening with age, subirregularly lobate, 5–8 cm diam.; *lobes* sublinear-elongate, older lobes often developing tangential cracks and becoming areolate, 1·0–2·5 mm wide. *Upper surface* opaque, emaculate, often with deep tangential cracks, lacking isidia and soredia; medulla white. *Lower surface* dark brown to pale brown, moderately rhizinate, rhizines dark brown, simple, *c.* 0·1 mm long. *Apothecia* adnate, 2–8 mm diam., disc dark brown to black, margin subintegral, exciple smooth; spores 8–10 × 5–7 μm.

CHEMISTRY. Thallus K−; medulla K−, C−, KC−, P+ orange-red; containing usnic acid, fumarprotocetraric acid, succinprotocetraric acid, and trace of protocetraric acid (±).

DISTRIBUTION. Southern and eastern Australia (Qld, NSW, ACT, Vic, SA, WA). Map 81. Also in South Africa. On rocks in drier tableland, subarid, and arid areas. Specimens examined: 53.

NOTES. This species belongs to the *X. lineola* group which are characterised by tightly adnate thalli, broad rotund marginal lobes, a pale lower surface, and by the upper surface of older lobes often being tangentially cracked. For a discussion of this group and a key see notes under *X. lineola*. The upper surface of *X. pertinax* usually has a distinctive yellow-olive tinge which is quite apparent in the field and usually enables one to distinguish this species from other



Map 81 Distribution of *Xanthoparmelia pertinax* in Australia.

members of this group. Even so, chemical tests (TLC) provide the only completely reliable means for separating the species.

Morphologically *X. pertinax* closely resembles *X. novomexicana* (Gyelnik) Hale from North America, but the latter contains only fumarprotocetraric acid with accessory physodalic and protocetraric acids, and rarely develops the tangential cracks and areolae typical of *X. pertinax*.

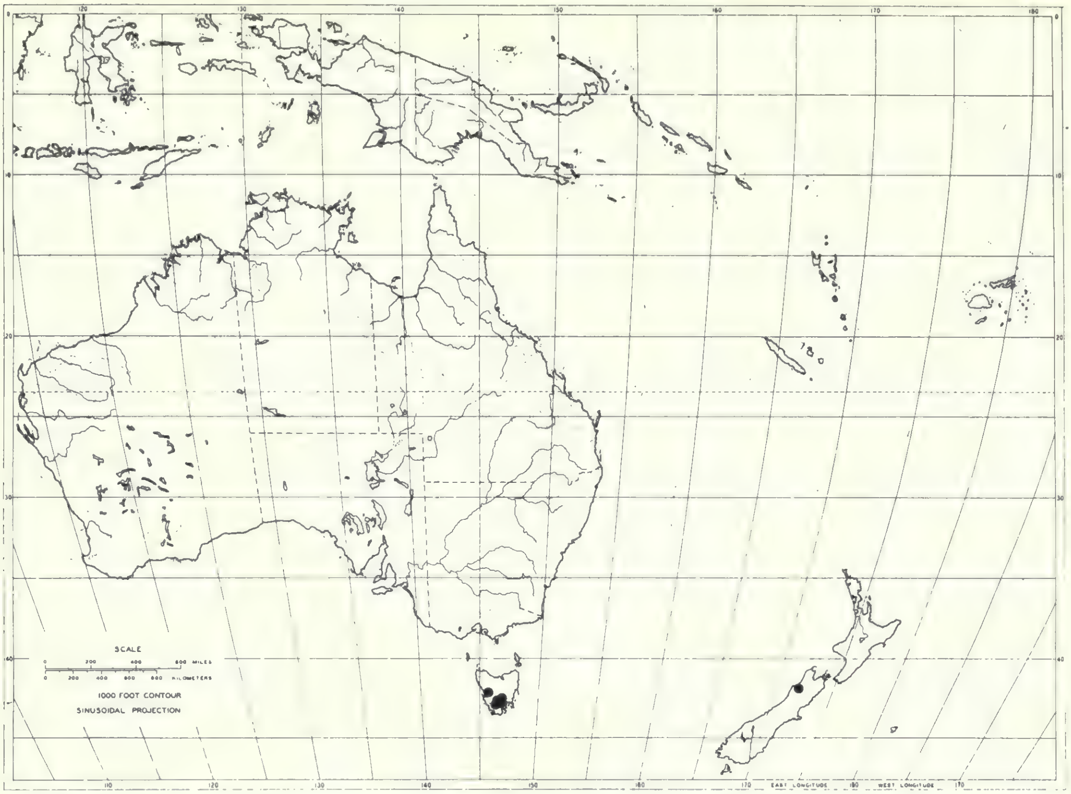
X. pertinax is relatively common on rocks in the drier inland areas of Australia, particularly the semi-arid chenopod shrublands of inland South Australia. It is often associated with *Acarospora schleicheri* (Ach.) Massal., *Pseudoparmelia scotophylla* (Kurok. & Filson) Hale, *Xanthoparmelia barbatica, X. filarszkyana, X. incrustata*, and *X. lineola*.

82. Xanthoparmelia phillipsiana (Filson) Elix & Jen Johnston, comb. nov.

Basionym: *Parmelia phillipsiana* Filson in *Muelleria* **4**: 324 (1981). Type: Australia, Macquarie Island, *c.* 1 km south of Double Point, cliffs on western side of island, 3 February 1964, *R. Filson* 5904 & *J. Phillips* (MEL 1024224! – holotype).

Illustration: Filson (op. cit.).

DESCRIPTION. *Thallus* small-foliose, adnate to the substrate, pale yellowish-green, with a narrow brownish-black zone at lobe margins, to 6 cm wide; *lobes* narrow, 0·5–1·5 mm wide, rotund at apices, contiguous throughout. *Upper surface* smooth, slightly shining, sparsely maculate, without soredia, densely isidiate, *isidia* cylindrical, coralloid, small and simple near margins, becoming taller (to 2 mm) and branched centrally, ± forming a dense mat; medulla white. *Lower surface* dark brown to black with sparse simple rhizines to the margins. *Apothecia* rare, sessile or substipitate, to 8 mm diam., disc red-brown to black-brown, flat then undulate, margin thin, crenate, margin and exciple isidiate; spores 7–9 × 5–6 μm.



Map 82 Distribution of *Xanthoparmelia phillipsiana* in Australia and New Zealand.

CHEMISTRY. Cortex K−; medulla K+ pale yellow, C−, KC−, P+ brick-red; containing usnic acid, stictic acid, constictic acid, traces of norstictic acid and cryptostictic acid.

DISTRIBUTION. Macquarie Island, Tasmania and South Island, New Zealand (Denniston Plateau). Map 82. On rocks in cooler mountain areas. Specimens examined: 10.

NOTES. This species is chemically identical and morphologically similar to the widespread *Xanthoparmelia mougeotina*, but differs from it in having shorter, more convex, contiguous lobes and tall, dense, coralloid isidia. By contrast *X. mougeotina* has sublinear-elongate lobes which are plane or concave and often stellate, and has sparse, simple isidia.

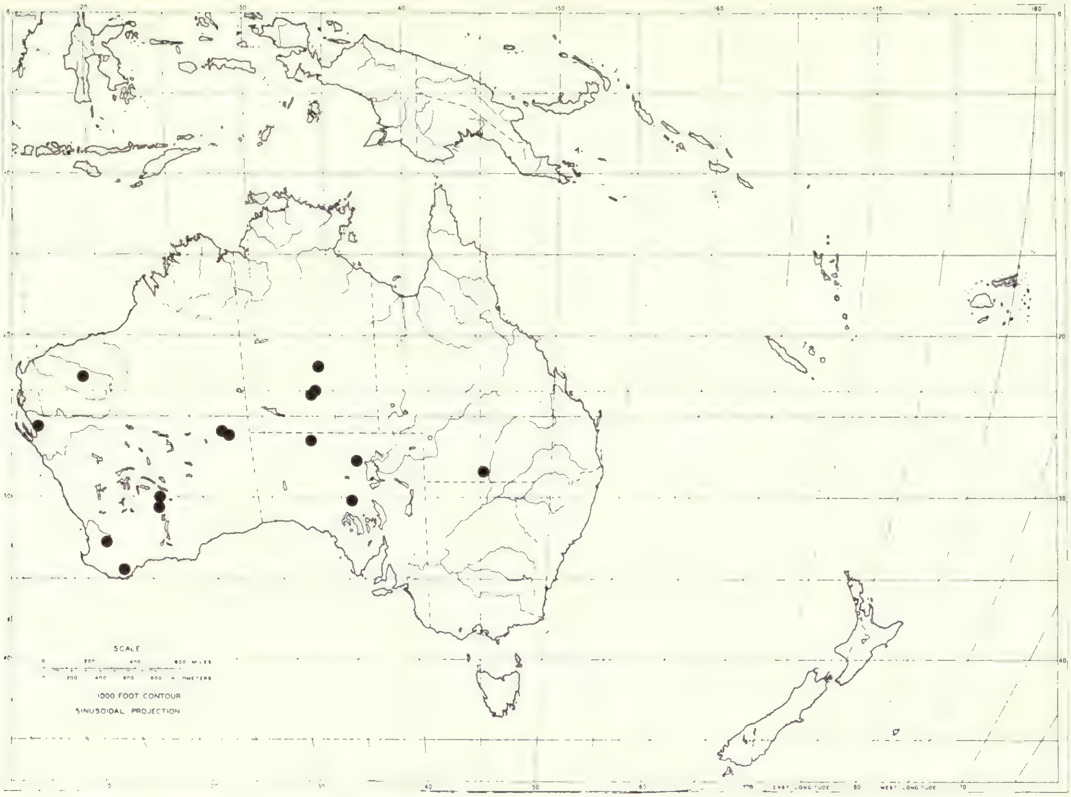
So far this species is the only *Xanthoparmelia* reported from Macquarie Island. It is relatively uncommon in Tasmania, where it occurs with *X. neotinctina, X. tegeta, X. mougeotina*, and *X. tasmanica*.

83. **Xanthoparmelia praegnans** (Elix & P. Armstr.) Elix & Jen Johnston, **comb. nov.**

Basionym: *Parmelia praegnans* Elix & P. Armstr. in *Aust. J. Bot.* **31**: 479 (1983). Type: Australia, South Australia, 11 km north of North Creek, 14·5 km north of Mount Dutton road sign, Marree–Oodnadatta road, on rocks of side of hill about 100 m east of road in south-west aspect, 21 September 1975, *R. Filson* 15626a & *S. Filson* (MEL 1014388! – holotype).

Illustration: Elix & Armstrong (op. cit.).

DESCRIPTION. *Thallus* small-foliose to subcrustose, tightly adnate, saxicolous, pale yellow, irregularly lobate, *c.* 2–4 cm diam.; *lobes* imbricate or not, 0·5–1·0(–2·0) mm wide, older lobes irregularly cracked and becoming areolate. *Upper surface* opaque, emaculate, with numerous isidia, *isidia* globose at first but becoming subcylindrical, branched, becoming erumpent (inflated at the apices and bursting open, but not sorediate); medulla white. *Lower surface* pale



Map 83 Distribution of *Xanthoparmelia praegnans* in Australia.

brown to brown, moderately rhizinate, rhizines simple, concolorous with lower surface. *Apothecia* adnate, 2–3 mm diam., concave at first, then undulate, margin thick, entire, smooth, disc dark brown; spores 7–8 × 5–5·5 μm.

CHEMISTRY. Thallus K−; medulla K+ yellow turning red, C−, KC−, P+ intense yellow. Thallus containing usnic acid, salazinic acid, consalazinic acid; ± traces of accessory protocetraric acid, norstictic acid, constipatic acid, and protoconstipatic acid.

DISTRIBUTION. Inland areas of Qld, SA, WA, and NT. Map 83. On rocks in subarid and arid areas. Specimens examined: 20.

NOTES. Morphologically and chemically this species closely resembles *Xanthoparmelia isidiosa* since both species have areolate, subcrustose thalli which bear erumpent isidia and contain usnic acid and salazinic acid. *X. isidiosa*, however, has a jet black lower surface in contrast to the pale brown lower surface of *X. praegnans*. Two other taxa have similar subcrustose thalli with a pale undersurface and erumpent isidia, viz., *X. dayiana* and *X. globulifera*. The distinctions between these species are discussed under *X. dayiana*.

X. praegnans is a scattered but relatively common species on rocks in arid inland areas of Australia. It is found associated with *Acarospora schleicheri* (Ach.) Massal., *Aspicilia* sp., *Caloplaca* sp., *Xanthoparmelia filarszkyana, X. globulifera, X. incerta, X. lineola, X. mexicana,* and *X. pertinax*.

84. Xanthoparmelia pseudoamphixantha (Elix) Elix & Jen Johnston, comb. nov.

Basionym: *Parmelia pseudoamphixantha* Elix in *Aust. J. Bot.* **29**: 365 (1981). Type: Australia, Victoria, 30 km west of Ouyen along Highway-12, on soil in mallee scrub, *J. A. Elix* 3682 (MEL! – holotype).
Illustration: Elix (op. cit.).

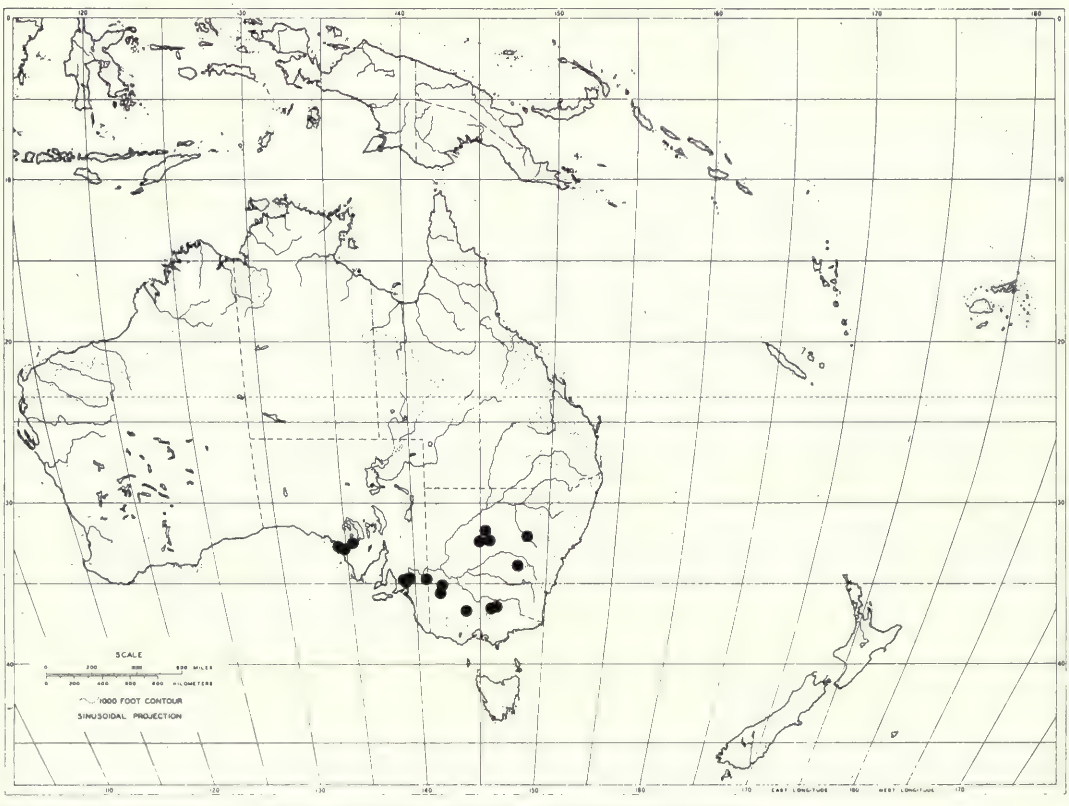
DESCRIPTION. *Thallus* foliose, loosely adnate on soil, pale yellow, forming rosettes 2–6 cm diam., dichotomously branched; *lobes* sublinear-elongate, often imbricate, ± separated near margins of thallus, 0·7–2·0(–3·0) mm wide. *Upper surface* dull, distinctly maculate, convex, not black-margined but often blackish-brown near the apices, neither isidiate nor sorediate; medulla white. *Lower surface* canaliculate or not, pale yellow to chestnut brown, sparsely to moderately rhizinate, rhizines black, simple or rarely sparsely branched, 1–2 mm long. *Apothecia* very rare, 0·8–1·5 mm diam., disc brown-black, weakly concave, with thick, persistent, involute ± undulating margin, exciple smooth; spores 5·5–7 × 4–5 μm.

CHEMISTRY. Thallus K−; medulla K+ yellow then orange-red, C−, KC−, P+ yellow; containing usnic acid, norstictic acid, connorstictic acid, salazinic acid (trace ±), hyposalazinic acid (trace ±).

DISTRIBUTION. Drier areas of NSW, Vic, and SA. Map 84. On soil in mallee scrub and *Callitris* woodland. Specimens examined: 34.

NOTES. This species is closely related to *X. amphixantha* and *X. reptans*. These three species have similar dichotomous lobes with a canaliculate lower surface and form small rosettes on soil. However, they are clearly separated by their chemical constituents since usnic, stictic, and constictic acids, together with traces of norstictic acid and cryptostictic acid, are present in *X. amphixantha*; fumarprotocetraric, succinprotocetraric, and usnic acids occur in *X. reptans*, and norstictic, connorstictic, and usnic acids in *X. pseudoamphixantha*. A key to the *X. amphixantha* group, and the justification for maintaining these taxa as distinct species, are given under *X. amphixantha*.

X. pseudoamphixantha is confined to soils in subarid areas where common associates include *Chondropsis semiviridis* (Nyl.) Nyl., *Psora decipiens* (Hedwig) Hoffm., *Acarospora ferdinandii*



Map 84 Distribution of *Xanthoparmelia pseudoamphixantha* in Australia.

(Müll. Arg.) Hue, *Xanthoparmelia amphixantha, X. flavescentireagens, X. mexicana*, and *X. terrestris*. It has a scattered distribution.

85. Xanthoparmelia pseudohypoleia (Elix) Elix & Jen Johnston, comb. nov.

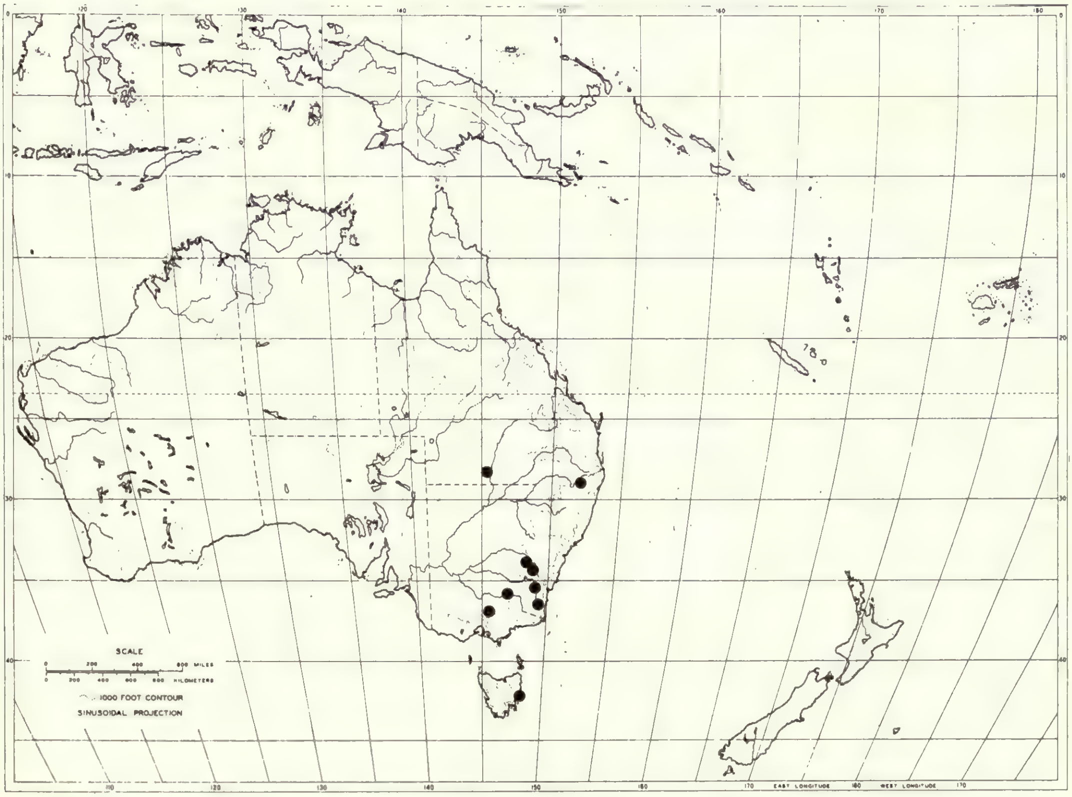
Basionym: *Parmelia pseudohypoleia* Elix in *Aust. J. Bot.* **24**: 667 (1976). Type: Australia, Australian Capital Territory, near Murray's Corner, on granite rocks along Paddys River, 550 m, *J. A. Elix* 1749 (MEL 1015394! – holotype; CANB! – isotype).
Illustration: Elix (op. cit.).

DESCRIPTION. *Thallus* foliose, moderately to loosely adnate on rocks, yellow-green, 5–8 cm diam.; *lobes* di- or trichotomously branched, narrow and sublinear-elongate, often imbricate, normally 0·5–1·0 mm wide but occasionally to 2 cm wide. *Upper surface* with distinct or effigurate maculae, lobes often black-margined, particularly towards apices, lacking isidia and soredia; medulla white. *Lower surface* black, rugulose or not, sparsely to moderately rhizinate, rhizines black, simple, robust, 0·5–1·5 mm long. *Apothecia* subsessile, 3–6 mm diam., disc dark brown, exciple maculate, margin thick, entire and involute at first, becoming dentate and cracked; spores 6–8 × 4–5 μm.

CHEMISTRY. Cortex K−; medulla K+ brownish, C−, P+ orange-red, containing usnic acid, fumarprotocetraric acid and ± traces of protocetraric acid, succinprotocetraric acid, lobaric acid (rare).

DISTRIBUTION. Southern and eastern Australia (Qld, NSW, ACT, Vic, Tas). Map 85. Rare. On rocks in mountain and tableland areas. Specimens examined: 12.

NOTES. Morphologically this species resembles *Xanthoparmelia hypoleia* in that both are



Map 85 Distribution of *Xanthoparmelia pseudohypoleia* in Australia.

narrow-lobate, have a black lower surface and effigurate maculae on the upper surface. It is, however, clearly distinguished chemically, because *X. hypoleia* contains protocetraric acid rather than fumarprotocetraric acid. Moreover *X. hypoleia* tends to be more tightly adnate than *X. pseudohypoleia*, while the lobes of the latter species are more regularly branched and linear-elongate.

This species also resembles other maculate species of the *X. hypoleia* group. The differentiation of these species and a key is given under *X. hypoleia.*

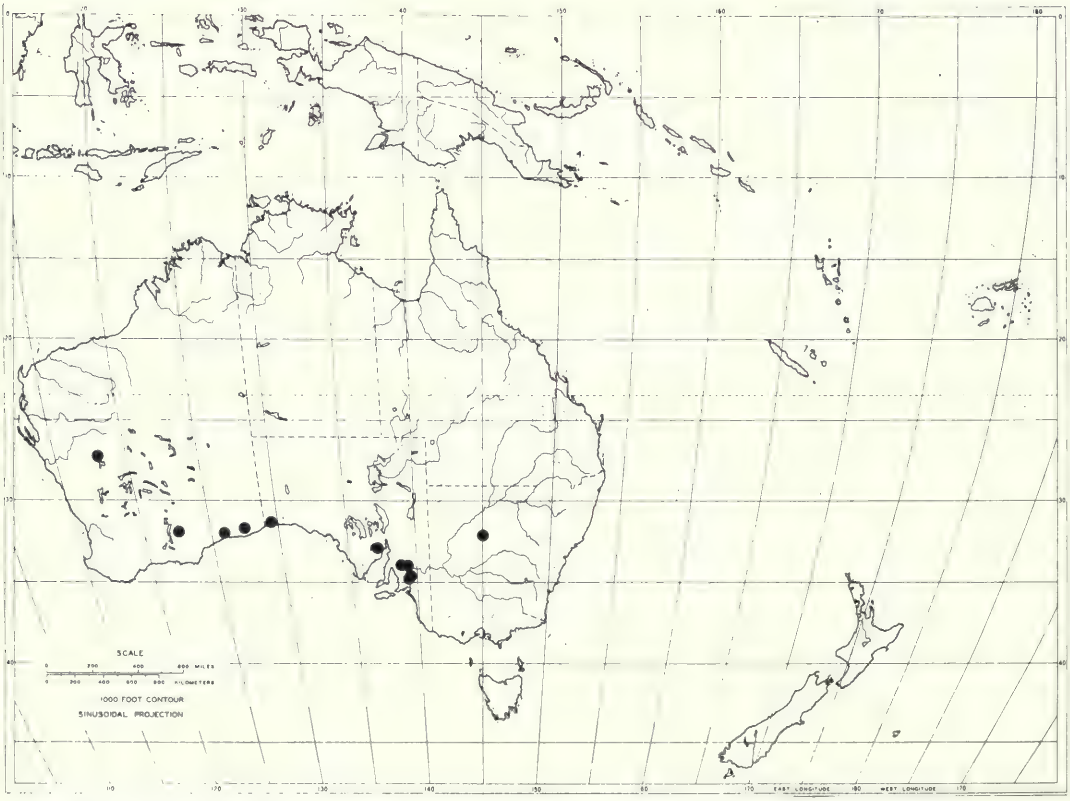
X. pseudohypoleia is a relatively rare species on rocks in more temperate areas of south-eastern Australia. Associated species include *Cladia aggregata* (Swartz) Nyl., *Cladonia pertricosa* Krempelh., *Xanthoparmelia amplexula, X. flavescentireagens, X. hypoprotocetrarica, X. eradicata*, and *X. tasmanica.*

86. Xanthoparmelia pumila (Kurok. & Filson) Elix & Jen Johnston, comb. nov.

Basionym: *Parmelia pumila* Kurok. & Filson in *Bull. natn. Sci. Mus. Tokyo* B, **1**: 42 (1975). Type: Australia, South Australia, Eyre Highway 40 km east of Kimba, on soil, *R. Filson* 11740 (MEL 1011825! – holotype).

Illustration: Kurokawa & Filson (op. cit.).

Description. *Thallus* foliose, adnate, terricolous, bright to pale yellow, often whitish-yellow at lobe apices, irregularly lobate, 3–10 cm diam.; *lobes* ± concave, not at all ascending, 0·7–1·5 mm wide, often lobulate, lobules branched, ascending, subterete to cylindrical, often blackened at the apices, 0·2–0·4 mm diam. *Upper surface* opaque, emaculate, ± rugulose, pruinose towards lobe apices; medulla white. *Lower surface* canaliculate or not, black but becoming brown to yellow near apices of marginal lobes, sparsely to moderately rhizinate, rhizines simple, slender,



Map 86 Distribution of *Xanthoparmelia pumila* in Australia.

black, 0·2–0·4 mm long. *Apothecia* very rare, to 2·5 mm in diam., disc flat to slightly concave, dark brown, margin thick, prominent, crenulate becoming incised; spores 10–11 × 5 μm.

CHEMISTRY. Thallus K−; medulla K+ yellow then red, C−, KC−, P+ intense yellow; containing usnic acid, salazinic acid, consalazinic acid, and traces of norstictic acid (±).

DISTRIBUTION. Drier hinterland areas of NSW, SA, WA. Map 86. On soil in mallee scrub and arid shrubland. Specimens examined: 30.

NOTES. This distinctive southern Australian species is characterised by the terricolous habit, the black lower surface, the development of subterete lobules in the centre of the thallus, and a white pruinose zone on the upper surface near the apices. It resembles *X. versicolor* and *X. molliuscula* in habit and growth form. However the latter species is chemically distinct because it contains stictic acid, constictic acid, and associated compounds, and has a pale lower surface. *X. versicolor* contains usnic acid and salazinic acid as does *X. pumila*, but develops a more robust thallus in which the main lobes are 1·0–2·5 mm wide, compared with the narrower lobes (0·7–1·5 mm) of *X. pumila*. Furthermore lobules in *X. versicolor* tend to be flat or slightly revolute, but never subterete as in *X. pumila*.

Morphologically *X. pumila* is virtually identical with *X. norpumila*, but the former has a more extensive distribution (compare Maps 77, 86) and can be distinguished chemically, since it contains norstictic acid and connorstictic acid in the medulla rather than salazinic acid.

A key to this group of species (the *X. versicolor* group) is presented under *X. versicolor*.

X. pumila is an uncommon species occurring on soil in subarid and arid areas where common associates include *Psora decipiens* (Hedwig) Hoffm., *Chondropsis semiviridis* (Nyl.) Nyl., *Xanthoparmelia reptans, X. convoluta, X. subdistorta*, and *X. terrestris*.

87. **Xanthoparmelia pustuliza** (Elix) Elix & Jen Johnston, **comb. nov.**

Basionym: *Parmelia pustuliza* Elix in *Aust. J. Bot.* **29**: 367 (1981). Type: Australia, Australian Capital Territory, Gudgenby River Gorge, 4·5 km south of Tharwa, on granite rocks, 660 m, *J. A. Elix* 6117 (MEL! – holotype).

Illustration: Elix (op. cit.).

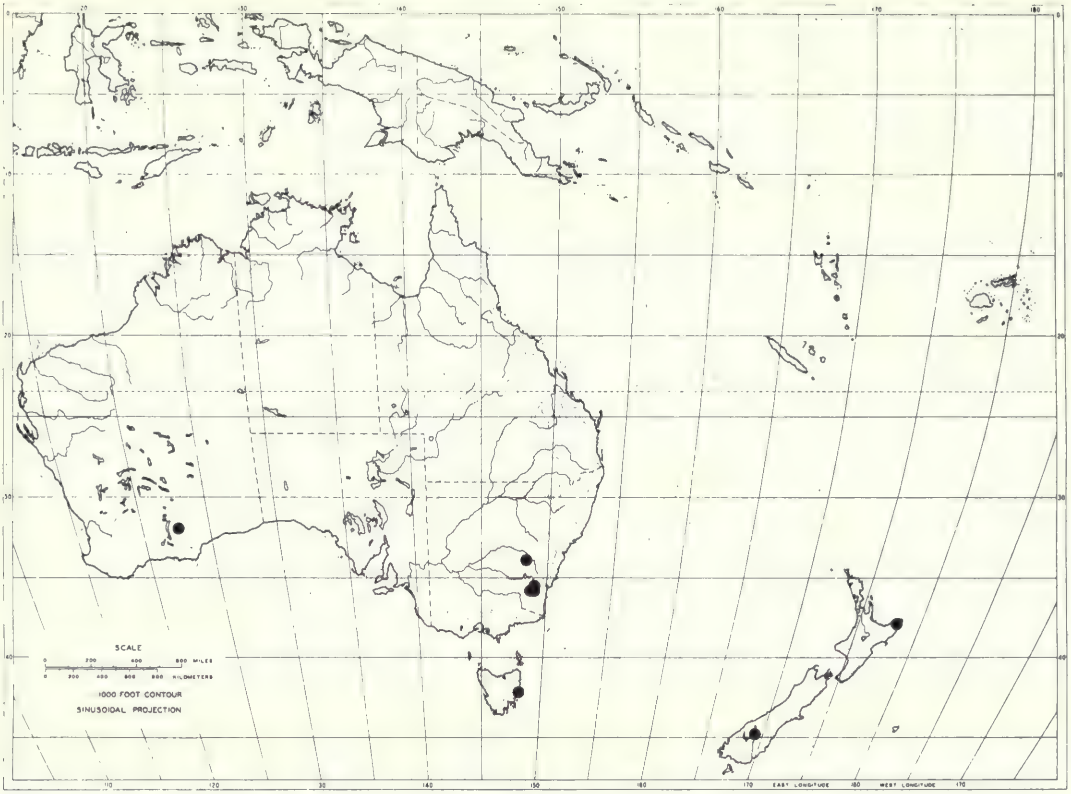
DESCRIPTION. *Thallus* foliose, tightly adnate on rocks, yellow-green, subirregularly lobate, 3–5 cm diam.; *lobes* sublinear-elongate, imbricate or not, 0·5–1·5(–2·0) mm wide. *Upper surface* shiny, flat, emaculate, often with tangential cracks, black-margined but soon developing numerous dactyls or wart-like isidia, *dactyls* globose, coarse and short at first and appearing granulate, later bursting open apically (the thallus appearing pustulate), eventually becoming coralloid and granular; medulla white. *Lower surface* black, moderately rhizinate, rhizines simple, black. *Apothecia* adnate, 1–3 mm diam., exciple smooth, disc dark brown; spores 6–9 × 3·5–5·5 μm.

CHEMISTRY. Thallus K−; medulla K+ yellow then orange-red, C−, KC−, P+ yellow; containing usnic acid, norstictic acid, connorstictic acid, ± traces of hypostictic acid, hyposalazinic acid, constipatic acid.

DISTRIBUTION. Southern Australia (NSW, ACT, Tas, WA) and New Zealand. Map 87. Rare on moist, exposed rocks in mountain areas. Specimens examined: 10.

NOTES. Like *X. cordillerana*, this peculiar species is characterised by the development of subpustulate isidia or open dactyls. The isidia or closed dactyls are coarse and globose at first with a granular surface. With age the isidia (dactyls) become subcylindrical, inflated and burst open at the apices, leaving behind a hollowed out crater so that the thallus appears pustulate. In places the dactyls appear more extensive and become coralloid-granulate. However, *X. cordillerana* is loosely adnate, has a pale lower surface and produces salazinic acid, while *X. pustuliza* is adnate, with much narrower lobes, a black lower surface, and produces norstictic and connorstictic acids.

In some respects this species resembles *X. isidiosa*, since both species have narrow, adnate



Map 87 Distribution of *Xanthoparmelia pustuliza* in Australia and New Zealand.

lobes with a black lower surface, and develop inflated isidia which burst open at the apices. However, the isidia are not at all granular in *X. isidiosa*, and this species contains usnic acid and salazinic acid.

X. pustuliza is a rare species confined to smooth, very moist rock surfaces where it associates with *X. amplexula, X. dichotoma, X. flavescentireagens, X. luminosa*, and *X. neotinctina*.

88. **Xanthoparmelia remanens** (Elix) Elix & Jen Johnston, **comb. nov.**

Basionym: *Parmelia remanens* Elix in *Aust. J. Bot.* **29**: 368 (1981). Type: Australia, New South Wales, 10 km east of Cooma along the Numeralla road, on granite rocks in pasture land, 910 m, *J. A. Elix* 1522 (MEL! – holotype).

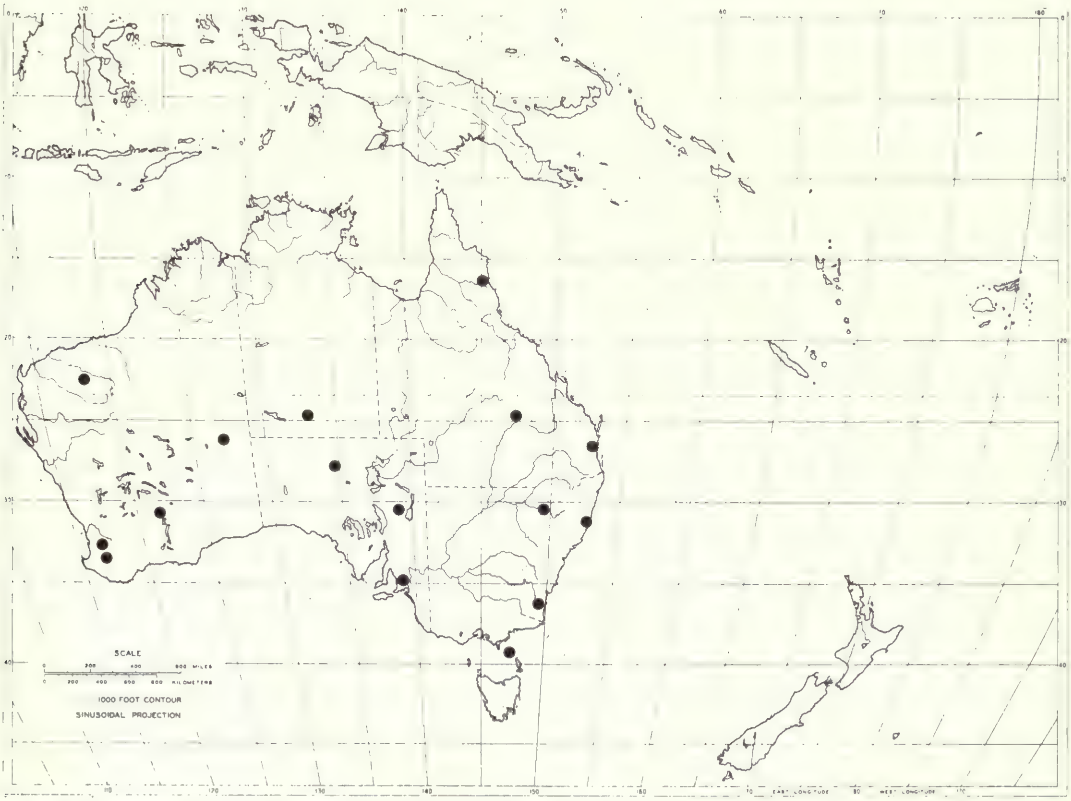
Illustration: Elix (op. cit.).

DESCRIPTION. *Thallus* foliose, adnate to tightly adnate on rocks, yellow-green, irregularly lobate, 4–6 cm diam.; *lobes* subirregular, imbricate or not, 1·5–3·0(–5·0) mm wide. *Upper surface* shiny, emaculate, sometimes rugulose, commonly black-margined near apices, moderately to densely isidiate, *isidia* warty at first, then cylindrical, ± inflated at apices but rarely erumpent, simple or branched and becoming coralloid, commonly with dark to blackened apices, to 0·2 mm high; medulla white. *Lower surface* pale brown to dark brown, moderately rhizinate, rhizines concolorous with underside, slender, simple. *Apothecia* rare, subpedicellate, 1–3 mm diam., concave, distorted, disc red-brown to dark brown, shining, margin entire, rather thick, involute, exciple smooth, shining, isidiate; spores 7–11 × 4–5·5 μm.

CHEMISTRY. Thallus K−; medulla K−, C−, KC−, P−; containing usnic acid, scabrosin 4,4′-diacetate, scabrosin 4-acetate-4′-butyrate, scabrosin 4,4′-dibutyrate, scabrosin 4-acetate-4′-hexanoate.

DISTRIBUTION. Southern and central Australia (Qld, NSW, Tas, SA, WA, NT). Map 88. Rare on rocks in coastal, upland, and arid areas. Specimens examined: 21.

NOTES. This species may be confused with *Xanthoparmelia scabrosa*, which is one of the most common species of *Xanthoparmelia* in Australasia. Although both species have warty isidia and lobes with a brown lower surface, *X. remanens* tends to be more tightly adnate than *X. scabrosa*, and the isidia only rarely become erumpent as they do in the latter. In addition, these species are clearly distinguished chemically because *X. remanens* lacks the metabolites loxodin and norlobaridone so characteristic of *X. scabrosa*. The scabrosin metabolites present in *X. remanens* in fact were isolated first from a chemical strain of *X. scabrosa* (Begg, Elix & Jones, 1978), but have now been detected in a number of other species of *Xanthoparmelia* and several of *Neofuscelia* (Culberson, Culberson & Esslinger, 1977). Although scabrosin metabolites are considered accessory compounds when they co-occur with loxodin and norlobaridone in *X. scabrosa*, these derivatives and usnic acid are the only secondary metabolites produced in *X. remanens*. Hence in this species these derivatives could be considered to be replacement rather than accessory metabolites or, alternatively, this taxon might be conceived as being an acid-deficient strain of *X. scabrosa*. Either way it would appear that this taxon should be given specific status (Hawksworth, 1976; Elix, 1982). *X. remanens* also resembles *X. exuviata*, but lacks the distinctive flaking upper cortex and has a different chemistry.



Map 88 Distribution of *Xanthoparmelia remanens* in Australia.

X. remanens is an uncommon species in Australia where typical associates include *Physcia caesia* (Hoffm.) Fürnrohr, *Neofuscelia pulla* (Ach.) Essl., *Xanthoparmelia amplexula, X. australasica, X. filarszkyana, X. flavescentireagens,* and *X. tasmanica*.

89. Xanthoparmelia reptans (Kurok.) Elix & Jen Johnston, comb. nov.

Basionym: Parmelia reptans Kurok. in Baker et al. in *Aust. J. Bot.* **21**: 137 (1973). Type: Australia, Victoria, Red Cliffs, on soil, *c.* 50 m, *S. Kurokawa* 6621 (TNS – holotype; MEL! – isotype).

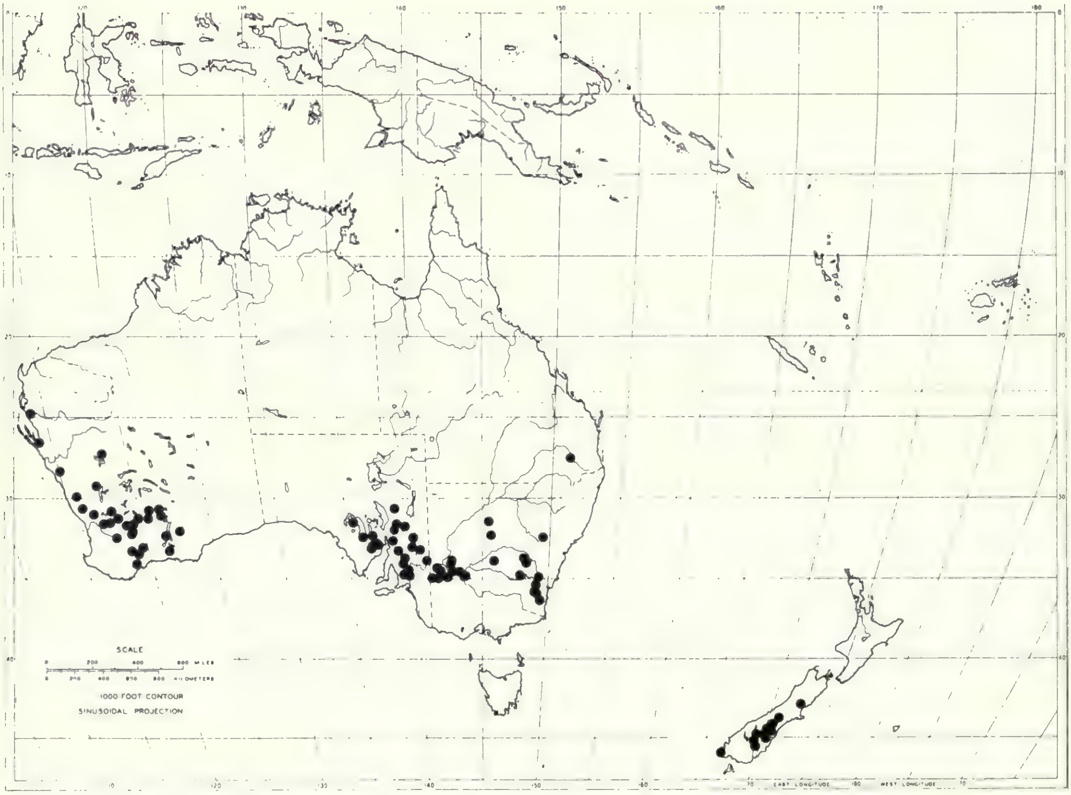
Illustration: Baker et al. (op. cit.); Galloway in *N.Z. Jl Bot.* **18**: 530 (1981) (as *X. amphixantha*); Filson & Rogers, *Lichens South Australia*: fig. 23A (1979).

DESCRIPTION. *Thallus* foliose, loosely adnate on soil, pale yellow, forming rosettes 1–5 cm diam., dichotomously branched; *lobes* sublinear-elongate, often imbricate, ± separated near thallus margin, 0·7–2 mm wide. *Upper surface* dull, maculate, particularly towards apices, convex, not black-rimmed but often pale blackish-brown near apex, neither isidiate nor sorediate; medulla white. *Lower surface* ± canaliculate, brownish yellow or pale blackish brown, yellow-rimmed, sparsely to moderately rhizinate, rhizines black, simple or rarely sparsely branched, 1–2 mm long. *Apothecia* rare, substipitate, 0·5–1·5 mm diam., disc weakly concave to ± flat, dark brown, margin thick, entire, involute, crenulate; exciple smooth, spores 6–7 × 4–5 μm.

CHEMISTRY. Cortex K−; medulla K+ brown, C−, P+ orange-red; containing usnic acid, fumarprotocetraric acid, succinprotocetraric acid (±) and traces of protocetraric acid (±), physodalic acid (±).

DISTRIBUTION. This species is confined to Australasia. In Australia it is found in the drier areas of Qld, NSW, ACT, Vic, SA, and WA. In New Zealand its occurs in Central Otago and Canterbury on South Island. Map 89. On soil in drier upland, subarid, and arid areas. Specimens examined: 201.

NOTES. This species belongs to the *X. amphixantha* group characterised by dichotomously divided lobes with a canaliculate lower surface, and by the thalli forming small rosettes on soils. A key to these species is given under *Xanthoparmelia amphixantha. X. reptans* is distinguished



Map 89 Distribution of *Xanthoparmelia reptans* in Australia and New Zealand.

by its chemistry and geographical distribution, being the most widely distributed of these species.

In New Zealand this species occasionally exhibits rhizines on both upper and lower surfaces; this phenomenon occurs when wind-borne thalli are overturned and then become stationary; the former upper surface then develops rhizines.

X. reptans is a widespread and common species, often found together with *Chondropsis semiviridis* (Nyl.) Nyl., *Xanthoparmelia concomitans, X. arapilensis, X. taractica, X. substrigosa,* and *X. terrestris*.

90. **Xanthoparmelia rogersii** Elix & Jen Johnston, **sp. nov.**

Thallus ut in *Xanthoparmelia tasmanica* sed lobis parce imbricatis et acidum fumarprotocetraricum et acidum succinprotocetraricum continenti differt. Superficies inferior nigra, sparsim rhizinata. Thallus 210–250 μm crassus; cortex superior 25–35 μm crassus, stratum gonidiale 14–35 μm crassum, medulla 125–160 μm crassa, cortex inferior 14–20 μm crassus. Thallus K−; medulla K+ hepaticus, C−, P+ aurantiaco-rubescens.

Type: Australia, Queensland, Girraween National Park, on slopes of The Pyramid, 28°53′S, 151°57′E, on granite boulders in *Eucalyptus* forest, *c.* 1100 m, 2 July 1984, *R. W. Rogers* 2871 pr. min. p. (MEL! – holotype).

Illustration: Fig. 32.

DESCRIPTION. *Thallus* foliose, loosely adnate on rocks, yellow-green, darkening with age, irregularly lobate, 6–8 cm diam.; *lobes* variable, irregular to sublinear-elongate, moderately to sparingly imbricate, 2·0–3·0(–5·0) mm wide, apices crenulate, ± rotund, occasionally develop-

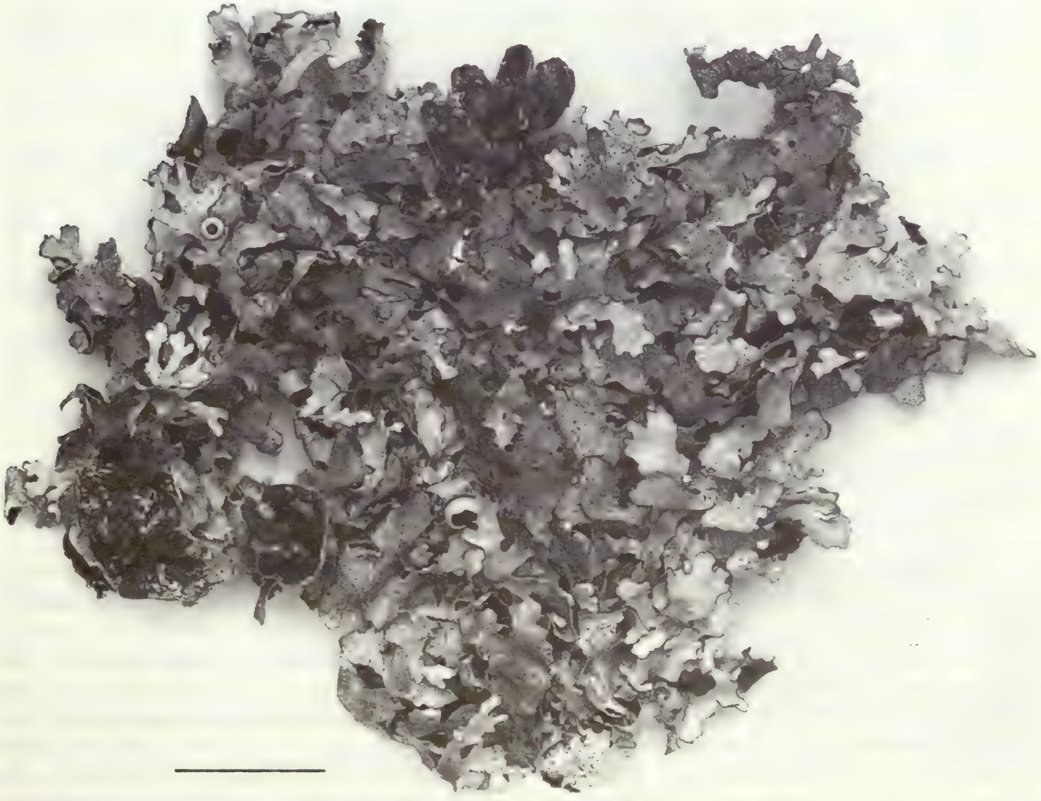
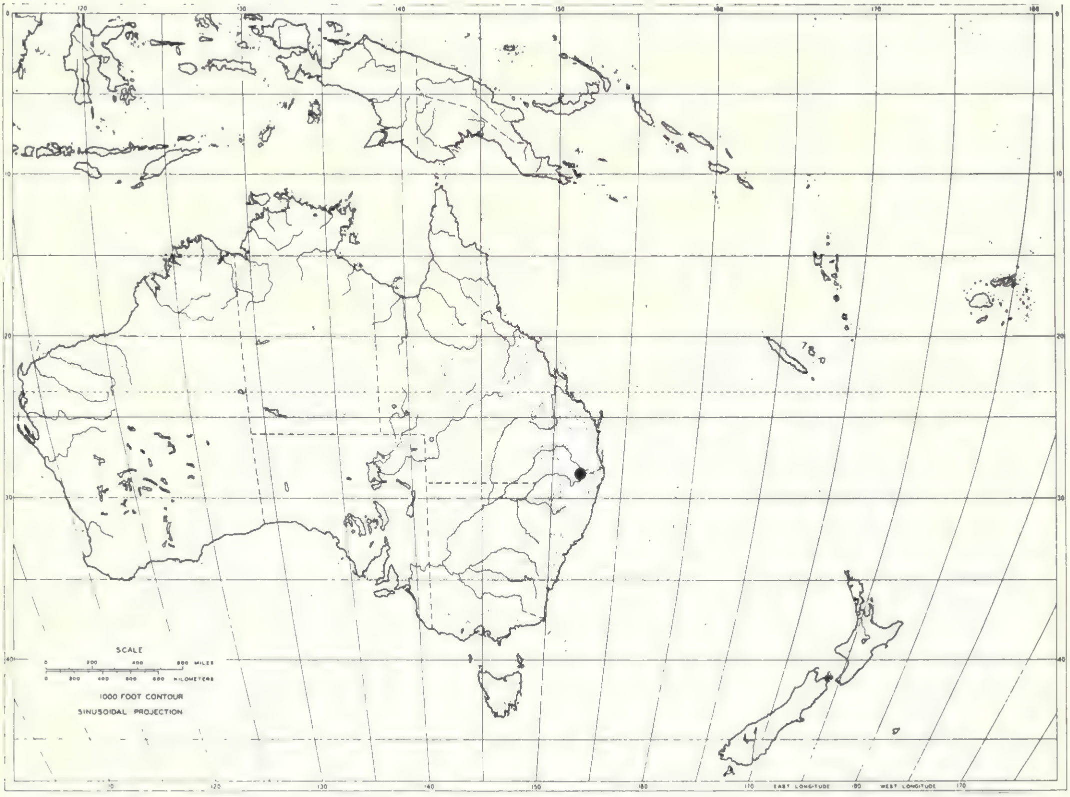


Fig. 32 *Xanthoparmelia rogersii* Elix & Jen Johnston. Holotype in MEL. Scale = 1 cm.

ing narrower (0·8–1·5 mm), subdichotomously divided secondary lobes. *Upper surface* dull, emaculate, lacking soredia and isidia, darkening with age, margin commonly blackened; medulla white. *Lower surface* jet black except for a narrow, brown, marginal zone, sparsely rhizinate, rhizines concolorous with lower surface, simple, robust. *Apothecia* scattered, adnate, to 12 mm diam.; disc concave then undulate-distorted, brown to black-brown, margin thick and involute at first, then thin, persistent; spores 8–9 × 5–6 μm.

Chemistry. Thallus K−; medulla K+ yellow-brown, C−, P+ orange-red; containing usnic acid, fumarprotocetraric acid, succinprotocetraric acid, and (±) trace of protocetraric acid.

Distribution. Hinterland zone of south-eastern Qld. Map 90. On rocks in upland areas with moderate rainfall. Specimens examined: 2.



Map 90 Distribution of *Xanthoparmelia rogersii* in Australia.

Notes. Morphologically this species closely resembles *Xanthoparmelia tasmanica*, as both species are loosely adnate on rocks and have broad lobes with a jet black lower surface. Although *X. rogersii* has broad lobes like *X. tasmanica*, it does not develop the densely imbricate secondary lobes so common and characteristic of the latter. Furthermore these two species have quite distinctive medullary chemistry: *X. rogersii* contains fumarprotocetraric and succinprotocetraric acids (K+ dingy yellow-brown), while *X. tasmanica* contains salazinic acid (K+ yellow-deep red). Chemically *X. rogersii* is identical with *X. hypomelaena*, and both species have a black lower surface. Essentially they differ in the degree of adnation to the substrate. The broad lobes (2·0–3·0 mm wide) of *X. rogersii* are loosely adnate, while the narrower (1·0–2·0 mm wide) lobes of *X. hypomelaena* are tightly adnate.

X. rogersii is a rare species known only from the ranges of south-eastern Queensland where it associates with *Parmelia erumpens* Kurok., *Punctelia subrudecta* (Nyl.) Krog, *Xanthoparmelia flavescentireagens, X. substrigosa,* and *X. tasmanica.*

This species is named in honour of one of Australia's foremost lichenologists, Dr R. W. Rogers of the University of Queensland.

91. **Xanthoparmelia rupestris** Elix & Jen Johnston, **sp. nov.**

Thallus ut in *Xanthoparmelia bungendorensi* sed lobis lineariter elongatis, subdichotome ramosis et subtus nigro vel fuliginoso. Thallus 85–140 μm crassus; cortex superior 14–18 μm crassus, stratum gonidiale 10–18 μm crassum, medulla 40–90 μm crassa, cortex inferior 14–20 μm crassus. Thallus K−; medulla K−, C−, KC−, P−.

Type: Australia, New South Wales, Tinderry Mountains, 12 km east of Michelago, 35°44′S, 149°17′E, on granite rocks, 1500 m, 26 May 1982, *T. H. Nash* 20, 455 (Herb. Arizona State Univ.!-holotype).

Illustration: Fig. 33.

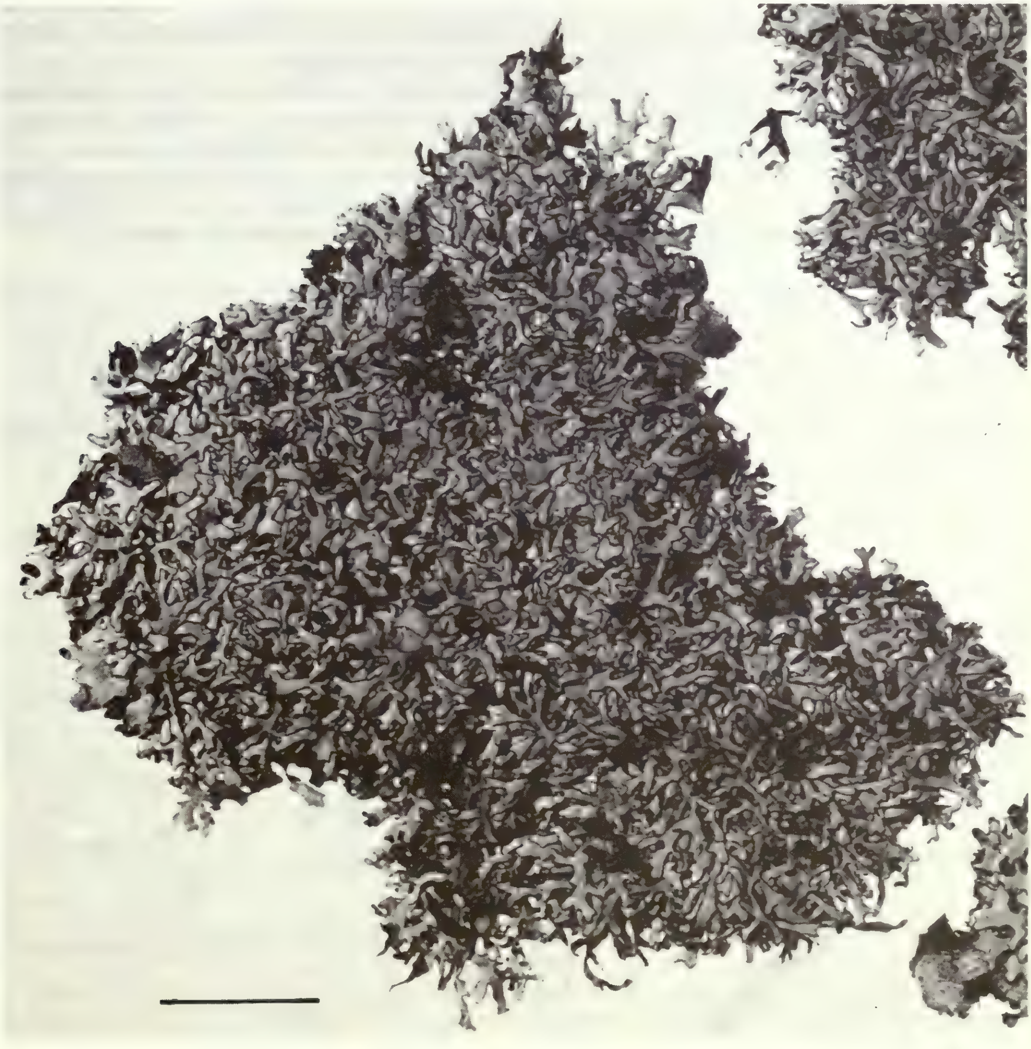


Fig. 33 *Xanthoparmelia rupestris* Elix & Jen Johnston. Holotype in Herb. Arizona State Univ. Scale = 1 cm.

Description. *Thallus* foliose, saxicolous, loosely attached to substrate, yellow-green, to 9 cm diam.; *lobes* linear-elongate, subdichotomously branched, divaricate in places, moderately imbricate, margin shining, black or brown, 0·5–1·5 mm wide. *Upper surface* smooth, shiny, emaculate, lacking soredia and isidia; medulla white. *Lower surface* black or very dark brown, sometimes with a paler zone towards apices, shining or matt, smooth, sparsely rhizinate, rhizines concolorous with lower surface, simple, ± tufted, robust. *Apothecia* not seen.

Chemistry. Thallus K−; medulla K−, C−, KC−, P−; containing usnic acid, scabrosin 4-acetate-4′-butyrate, scabrosin 4-acetate-4′-hexanoate, scabrosin 4,4′-dibutyrate, and traces of scabrosin 4,4′-diacetate.

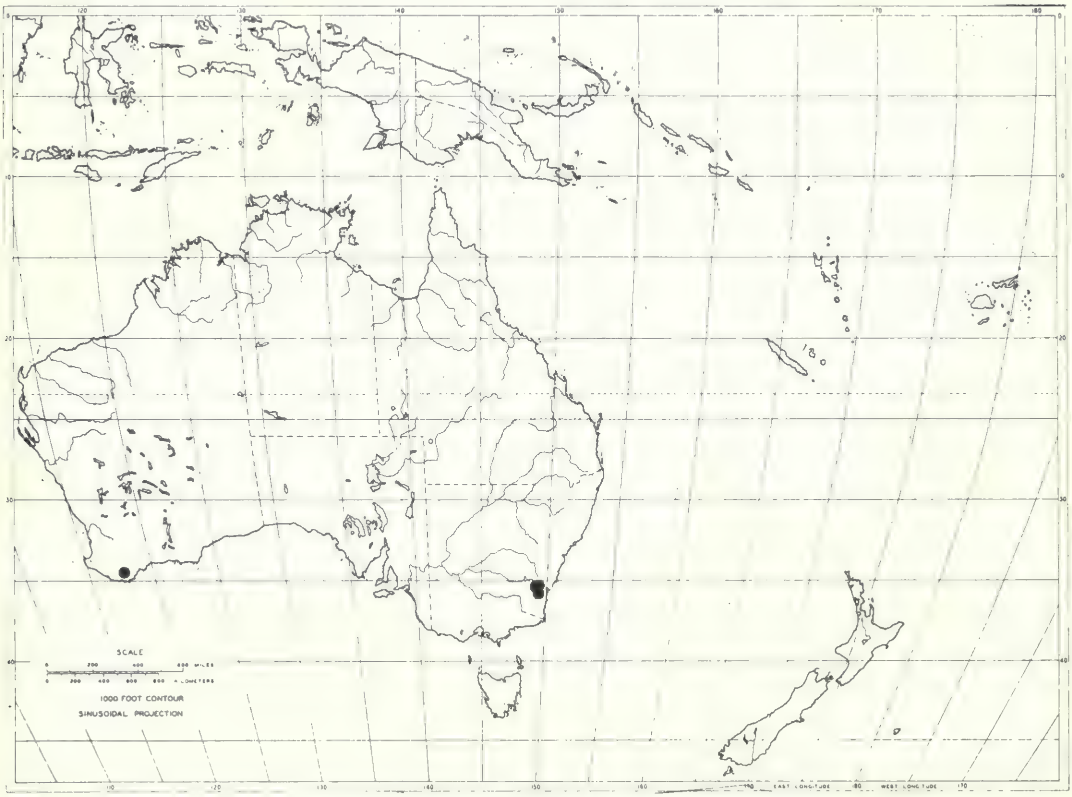
Distribution. Only known from the southern tablelands (ACT, NSW) and the Porongurup Range, WA. Map 91. Loosely adnate on subalpine rocks. Specimens examined: 5.

Notes. This species is distinguished by a unique combination of characters: narrow, linear-elongate lobes with subdichotomous branching, a brown-black to black lower surface with sparse rhizines, and production of scabrosin metabolites in the medulla.

Chemically this species is identical with *Xanthoparmelia bungendorensis*, a species with a similarly loosely adnate thallus, but the lobes are broader (1·0–4·0 mm wide cf. 0·5–1·5 mm), more irregularly divided, and have a pale tan to brown lower surface.

Morphologically, *X. rupestris* comes close to *X. dichotoma*, although the latter species tends to have more markedly elongate lobes with regular dichotomous branching. Further, *X. dichotoma* invariably produces loxodin and norlobaridone in the medulla (KC+ rose).

X. rupestris appears to be rare, known only from a few localities, where it grows on subalpine granite rocks together with *Parmelia signifera* Nyl., *Hypogymnia tubularis* (Taylor) Elix, *Xanthoparmelia dichotoma, X. subnuda, X. eradicata, X. scabrosa,* and *X. tasmanica*.



Map 91 Distribution of *Xanthoparmelia rupestris* in Australia.

92. **Xanthoparmelia scabrosa** (Taylor) Hale

in *Phytologia* **28**: 488 (1974).

≡ *Parmelia scabrosa* Taylor in *Lond. J. Bot.* **6**: 162 (1847). Type: Australia, Swan River, 1843, *J. Drummond* (FH! – lectotype; BM – isotypes).

= *Parmelia conspersa* var. *hypoclystoides* Müll. Arg. in *Flora, Jena* **66**: 48 (1883). Type: Australia, Victoria, Mt Macedon, *Moffat* 41 (G! – lectotype).

≡ *Parmelia hypoclystoides* (Müll. Arg.) Gyelnik in *Annls hist.-nat. Mus. natn. hung.* **29** (Bot.): 25 (1935).

≡ *Xanthoparmelia hypoclystoides* (Müll. Arg.) Hale in *Phytologia* **28**: 487 (1974).

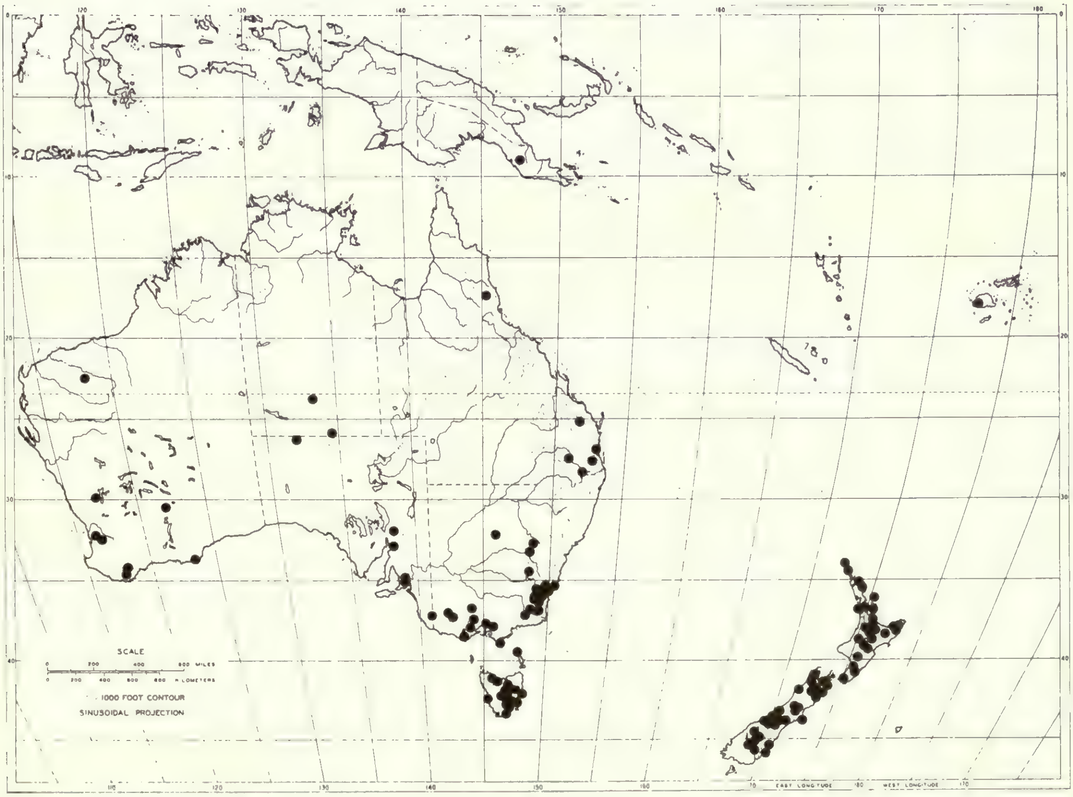
= *Parmelia linkolae* Gyelnik in *Magy. bot. Lap.* **28**: 60 (1930). Type: New Zealand, Dunedin, *Lindsay* (H – NYL, herb. no. 34708! – lectotype).

= *Parmelia scabropustulata* Elix in *Aust. J. Bot.* **29**: 369 (1981). Type: New Zealand. Christchurch, Port Hills, Ellas Track, on exposed volcanic rocks, 480 m, *J. A. Elix* 7612 (CHR! – holotype; MEL! – isotype).

Illustration: Elix (op. cit.) (as *Parmelia scabropustulata*).

DESCRIPTION. *Thallus* foliose, adnate on rocks, yellow-green, subirregularly lobate, *c.* 5 cm diam.; *lobes* sublinear-elongate, imbricate or not, 0·8–2·0(–3·0) mm wide. *Upper surface* opaque, emaculate, with numerous isidia, *isidia* globose or warty at first, sometimes becoming cylindrical and branched, erumpent, (inflated at the apices with the apices breaking open, becoming granular but not truly sorediate); medulla white. *Lower surface* pale brown to dark brown, somewhat darker towards lobe apices, sparsely to moderately rhizinate, rhizines concolorous with lower surface, simple, slender. *Apothecia* to 7 mm diam., disc strongly concave at first, less so at maturity, dark brown, shining, margin persistent, strongly involute at first, isidiate; spores 8–12 × 5–6 μm.

CHEMISTRY. Thallus K−; medulla K−, C−, KC+ rose, P−; containing usnic acid, loxodin,



Map 92 Distribution of *Xanthoparmelia scabrosa* in Australasia.

norlobaridone, scabrosin 4,4′-diacetate (±), scabrosin 4-acetate-4′-butyrate (±), scabrosin 4,4′-dibutyrate (±), scabrosin 4-acetate-4′-hexanoate (±) and rarely traces of isonorlobaridone (±), norlobariol (±) and norlobariol methyl ester (±), conloxodin (±), conorlobaridone (±). See also Foo & Galloway (1979).

DISTRIBUTION. Common in southern Australia (Qld, NSW, ACT, Vic, Tas, SA, WA, NT) and New Zealand. Map 92. Also in Papua New Guinea, Fiji, South Africa, and Japan. On rocks, soil, wood, and several man-made substrates from sea-level to subalpine zones. Specimens examined: 300.

NOTES. The presence of isidia, the pale brown lower surface, and the production of usnic acid, loxodin, and norlobaridone are features which immediately call *Xanthoparmelia amplexula* to mind. This and other related species are discussed under *X. amplexula*. *X. scabrosa* differs from *X. amplexula* in the nature of the isidia; *X. amplexula* has slender, cylindrical isidia which may or may not be branched, while in *X. scabrosa* the isidia are warty or globose at first, and develop into subcylindrical isidia which become inflated at the apices and burst open. In this respect this species resembles *X. cordillerana* and *X. flindersiana*, two other foliose species with a pale lower surface and ± branched isidia which develop into inflated and erumpent dactyls or isidia. *X. scabrosa* is clearly distinguished from *X. flindersiana* by the more loosely adnate lobes and the production of loxodin and norlobaridone. *X. flindersiana* contains norstictic acid, and *X. cordillerana* salazinic acid in addition to usnic acid. Although *X. cordillerana* is moderately to loosely adnate like *X. scabrosa*, it is readily differentiated chemically and also the lobes are broader (2·0–5·0 mm wide cf. 0·8–2·0 mm) and irregular, rather than sublinear-elongate. *X. scabrosa* also closely resembles *X. verdonii* in both morphology and chemistry. However *X. verdonii* generally has a more tightly adnate, coriaceous thallus and a jet black lower surface, while *X. scabrosa* is more loosely adnate and has a brown to dark brown lower surface.

X. scabrosa has a wide substrate tolerance and, although predominantly found on rock in undisturbed sites, it will also colonize tree bark, decorticated wood, slate, roofing tiles, and glass, and will also grow over bryophytes on soil. In wetter areas it is common on bitumen paths and roads, growing rapidly on these substrates. When growing over mosses and bryophytes, *X. scabrosa* often develops subterete, dichtomously branched lobes. *X. scabrosa* is one of the most common species of *Xanthoparmelia* in Australasia and, together with *X. flavescentireagens* and *X. tasmanica*, may be found in most colonies of these lichens.

93. **Xanthoparmelia spargenosa** Elix & Jen Johnston, **sp. nov.**

Thallus ut in *Xanthoparmelia nebulosa* sed arcte adnatus et acidum exuviaticum B continenti etiam differt. Superficies inferior pallido-brunnea, sparsim rhizinata. Thallus 140–175 μm crassus; cortex superior 14–20 μm crassus, stratum gonidiale 20–28 μm crassum, medulla 85–120 μm crassa, cortex inferior *ca.* 14 μm crassus. Thallus K−; medulla K−, C−, KC−, P−.

Type: Australia, Queensland, on road to Crows Nest Falls, south of Kingaroy, on granite rocks in pasture land, 17 June 1982, *M. E. Hale* 65004 (US! – holotype).

Illustration: Fig. 34.

DESCRIPTION. *Thallus* moderately to loosely adnate on rocks, yellow-green, *c.* 5 cm diam.; *lobes* subirregular, strongly imbricate, contiguous or not, 1·0–2·5 mm wide, apices crenulate, ± rotund; secondary lobes narrower, 0·5–1·0 mm wide, imbricate and ± entangled. *Upper surface* shiny, emaculate, often black-margined particularly towards lobe apices, lacking soredia and isidia; medulla white. *Lower surface* pale ivory to brown, sparsely rhizinate, rhizines concolorous with lower surface, simple, robust, often grouped subapically. *Apothecia* adnate, 1–3 mm diam., disc shallowly concave, dark brown; margin thin, persistent, becoming ± undulate, spores 8–10 × 5–6·5 μm.

CHEMISTRY. Thallus K−; medulla K−, C−, KC−, P−; containing usnic acid, exuviatic acid B, exuviatic acid A (±).

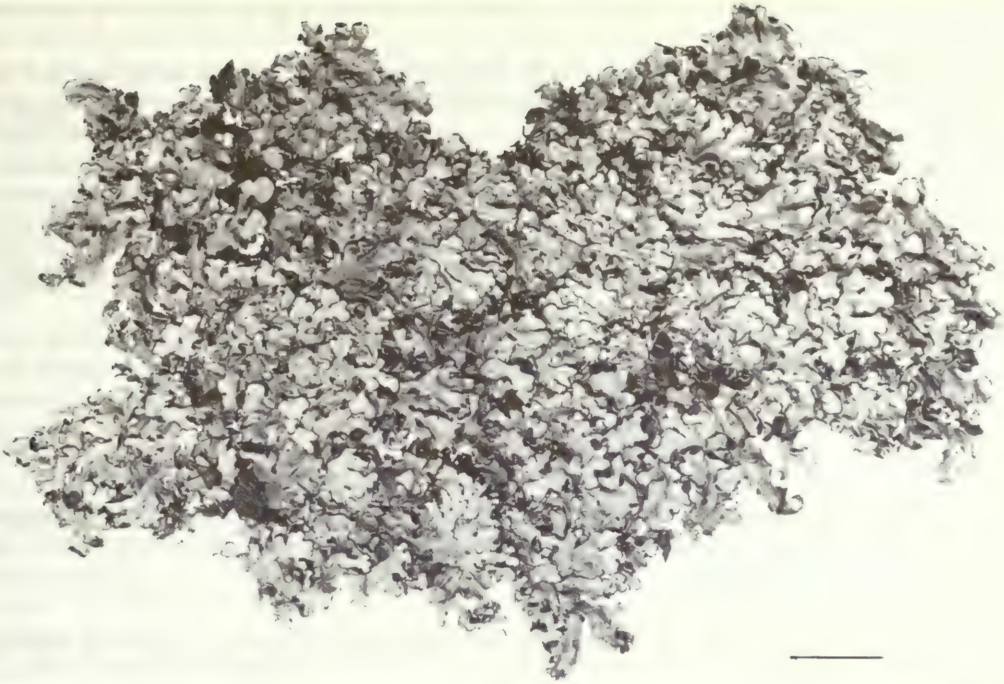
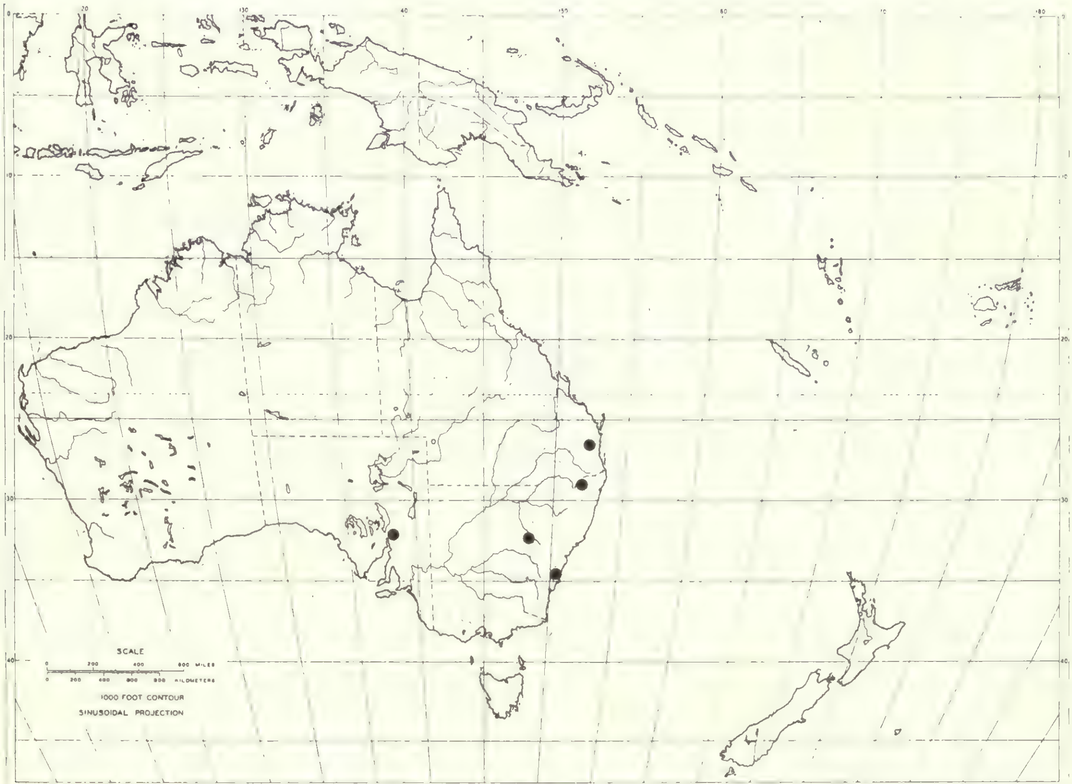


Fig. 34 *Xanthoparmelia spargenosa* Elix & Jen Johnston. Portion of holotype in US. Scale = 1 cm.


SCALE
0 200 400 600 MILES
0 200 400 600 800 KILOMETERS
1000 FOOT CONTOUR
SINUSOIDAL PROJECTION
EAST LONGITUDE
WEST LONGITUDE

Map 93 Distribution of *Xanthoparmelia spargenosa* in Australia.

Distribution. Qld, NSW, SA. Map 93. On rocks in subtropical or subarid areas. Specimens examined: 5.

Notes. Morphologically this species closely resembles *Xanthoparmelia nebulosa* and some specimens of *X. flavescentireagens*. The latter species differs in often developing elongated, subdichotomously divided secondary lobes, a feature not observed in the other two species. Furthermore, *X. flavescentireagens* invariably produces loxodin and norlobaridone in the medulla (KC+ rose), while *X. nebulosa* produces usnic acid and traces of constipatic acid and related aliphatic acids, and *X. spargenosa* usnic acid, exuviatic acid B and ± exuviatic acid A (aliphatic acids of unknown structure). Although *X. spargenosa* is generally more tightly adnate than *X. nebulosa*, the latter two species are distinguished most reliably by chemical means. *X. spargenosa* appears to be the fertile counterpart of *X. exuviata*.

It appears to be a rare species; little is known of its ecology and associates.

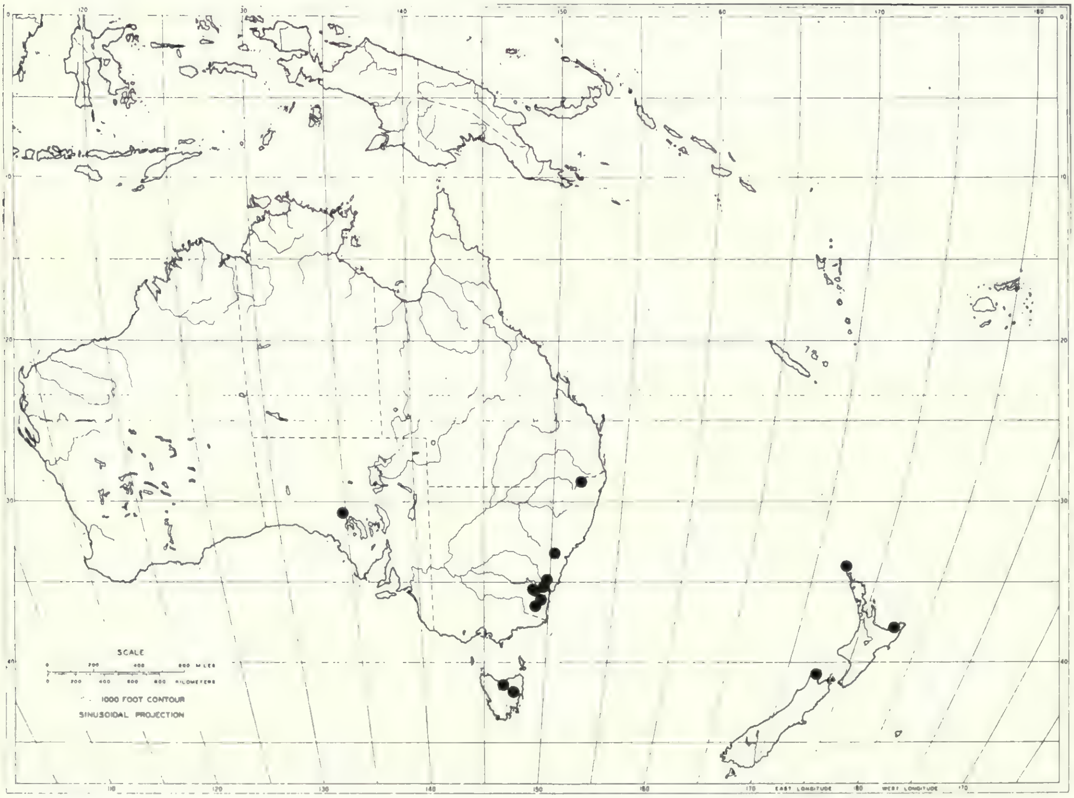
This species was discovered by Dr M. E. Hale, and we wish to thank him for bringing it to our attention.

94. **Xanthoparmelia streimannii** (Elix & P. Armstr.) Elix & Jen Johnston, **comb. nov.**

Basionym: *Parmelia streimannii* Elix & P. Armstr. in *Aust. J. Bot.* **31**: 481 (1983). Type: Australia, New South Wales, Teudts Hill, 5 km south-west of Bundanoon, on sandstone rocks, 680 m, 17 September 1980, *J. A. Elix* 8977 & *H. Streimann* (MEL! – holotype).

Illustration: Elix & Armstrong (op. cit.).

Description. *Thallus* foliose, loosely adnate on rocks, yellow-green, darkening with age, radiating at first, becoming irregularly lobate, 4–7 cm diam.; *lobes* imbricate or not, sublinear-elongate, 0·5–1·5(–2·0) mm wide, older lobes irregularly fractured and areolae commonly



Map 94 Distribution of *Xanthoparmelia streimannii* in Australia and New Zealand.

formed. *Upper surface* opaque, emaculate, commonly with tangential cracks, densely isidiate, *isidia* cylindrical at first, becoming extensively branched and coralloid; medulla white. *Lower surface* pale brown, becoming darker near lobe apices, moderately rhizinate, rhizines simple, brown. *Apothecia* adnate, to 5 mm diam., disc concave then ± flat, dark brown, margin entire, thin, isidiate; spores 7–9 × 5–6 μm.

CHEMISTRY. Cortex K−; medulla K+ yellow becoming red, C−, KC−, P+ yellow; containing usnic acid, norstictic acid, connorstictic acid, and (±) traces of salazinic acid.

DISTRIBUTION. Southern and eastern Australia (Qld, NSW, ACT, Tas, SA) and New Zealand (North and South Island, Three Kings Is.). Map 94. Rare. On rocks in coastal areas and adjacent ranges. Specimens examined: 24.

NOTES. Morphologically this species closely resembles *X. antleriformis*, a species with narrow lobes, pale lower surface, and dense coralloid isidia. However, *X. streimannii* has consistently broader lobes (0·5–1·5 mm wide cf. 0·3–0·8 mm) and tends to be more tightly adnate than *X. antleriformis*. Furthermore, *X. streimannii* produces norstictic and connorstictic acids in the medulla, while *X. antleriformis* contains salazinic acid. Chemically *X. streimannii* is identical with *X. flindersiana*, but the latter species has broad, tightly adnate lobes and the isidia become erumpent at the apices. This species also resembles the American species *X. dierythra* (Hale) Hale, but *X. streimannii* has narrower lobes, is more loosely adnate than *X. dierythra*, and is characterised by the extensively branched, coralloid isidia. The isidia of *X. dierythra* are moderate to dense, cylindrical, simple or rarely branched. Also *X. streimannii* has significantly larger spores (7–9 × 5–6 μm cf. 5–6 × 4–5 μm) than *X. dierythra*.

X. streimannii has a scattered distribution, locally common on Hawkesbury sandstone (eastern NSW) and Three Kings Islands in northern New Zealand. In Australia associates include *Cladia aggregata* (Swartz) Nyl., *Hypogymnia subphysodes* (Krempelh.) Filson, *Xanthoparmelia antleriformis, X. neotinctina*, and *X. tegeta*. In New Zealand the species is accompanied by *X. australasica, X. mexicana*, and *X. scabrosa*.

95. **Xanthoparmelia subcrustacea** (Gyelnik) Hale

in *Mycotaxon* **20**: 79 (1984).

≡ *Parmelia subcrustacea* Gyelnik in *Annls hist.-nat. Mus. natn. hung.* **29** (Bot.): 30 (1935).

≡ *Parmelia conspersa* var. *stenophylloides* Müll. Arg. in *Hedwigia* **31**: 193 (1892). Type: Australia, South Australia, Everard Ranges, on rocks, *Helms* 95 (G! – lectotype).

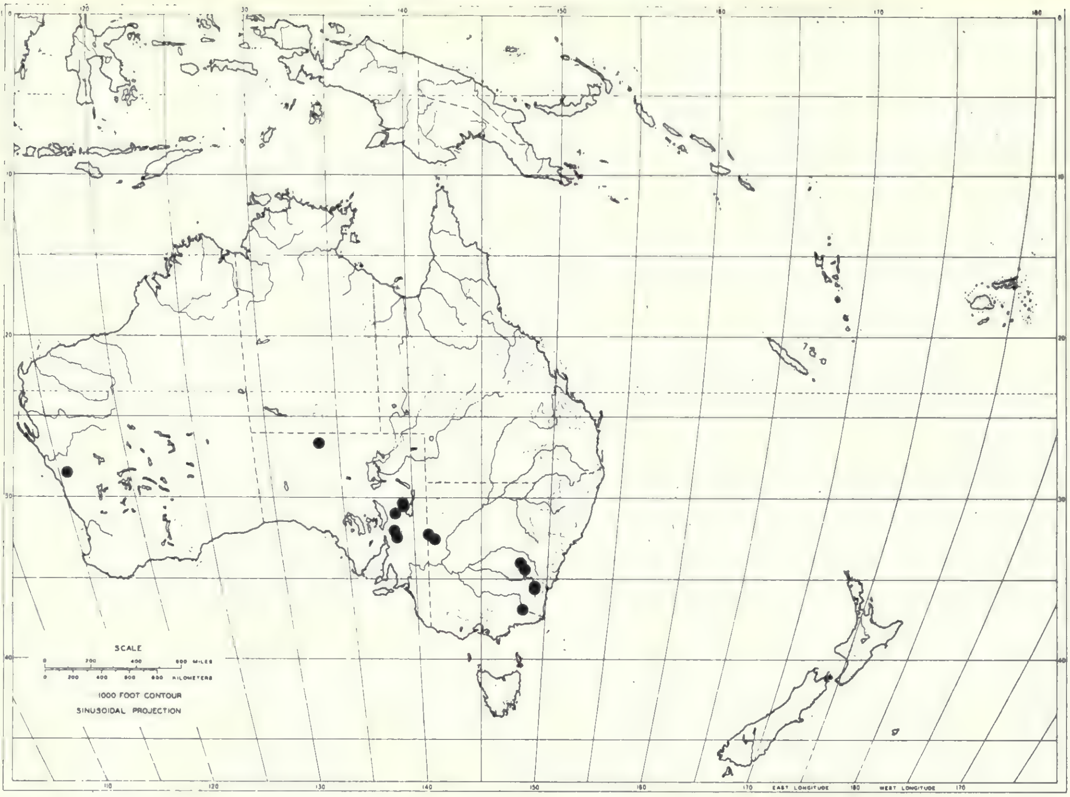
Illustration: Elix in *Aust. J. Bot.* **29**: 371 (1981).

DESCRIPTION. *Thallus* small-foliose to subcrustose, tightly adnate on rocks, yellow-green, darkening with age, subirregularly lobate, 3-4 cm diam.; *lobes* subirregular to sublinear-elongate, not at all imbricate, older lobes irregularly fractured and areolae extensively formed, lobes 0·5–1·0(–1·5) mm wide, areolae 0·2–1·0 mm diam. *Upper surface* sub-shiny, emaculate, often tangentially cracked, commonly black-margined, particularly towards lobe apices, lacking isidia and soredia; medulla white. *Lower surface* pale brown, often somewhat darker to smoky-grey near lobe apices, moderately rhizinate, rhizines brown, simple. *Apothecia* adnate, 1·0–1·5 mm diam., disc black-brown, margin entire, involute at first then undulating; spores 6–9·5 × 4·5–6 μm.

CHEMISTRY: Thallus K−; medulla K+ pale reddish, C−, KC−, P−; containing usnic acid, hypostictic acid, hyposalazinic acid, hypoconstictic acid (±) and accessory constipatic acid (±).

DISTRIBUTION. Drier areas of NSW, ACT, Vic, SA, and WA. Map 95. On rocks in drier mountain, subarid, and arid areas. Specimens examined: 20.

NOTES. This species appears similar morphologically to *X. cravenii* and *X. lineola* because both these lichens are tightly adnate on rocks, form areolae on older parts of the thallus, and have a pale brown lower surface. However, *X. subcrustacea* has narrower lobes (0·5–1·0 mm wide cf. 1·0–2·5 mm) than *X. lineola*, and also is distinct chemically since the latter contains salazinic



Map 95 Distribution of *Xanthoparmelia subcrustacea* in Australia.

acid, while *X. cravenii* has lobes of intermediate width (0·8–2·0 mm) and contains scabrosin derivatives. A key to these species groups is given under *X. lineola* and *X. dubitata*. Chemically, *X. subcrustacea* is identical with the South African species *X. quintaria* (Hale) Hale, but morphologically these two species are very different. *X. quintaria* has loosely adnate, imbricate, linear, almost divaricate lobes, while the thallus of *X. subcrustacea* is much more tightly adnate and subirregularly lobate, the lobes not at all imbricate but becoming cracked, areolate, and more or less subcrustose in the older parts. The fatty acid, constipatic acid, appears as an accessory compound in *X. subcrustacea*.

X. subcrustacea is an uncommon species, tightly adnate to rocks in central Australia and the drier areas of southern Australia. It is found together with *Acarospora schleicheri* (Ach.) Massal., *Caloplaca* sp., *Xanthoparmelia cravenii, X. lineola, X. pertinax, X. subdomokosii,* and *X. weberi*.

96. **Xanthoparmelia subdistorta** (Kurok.) Hale

in *Phytologia* **28**: 489 (1974).

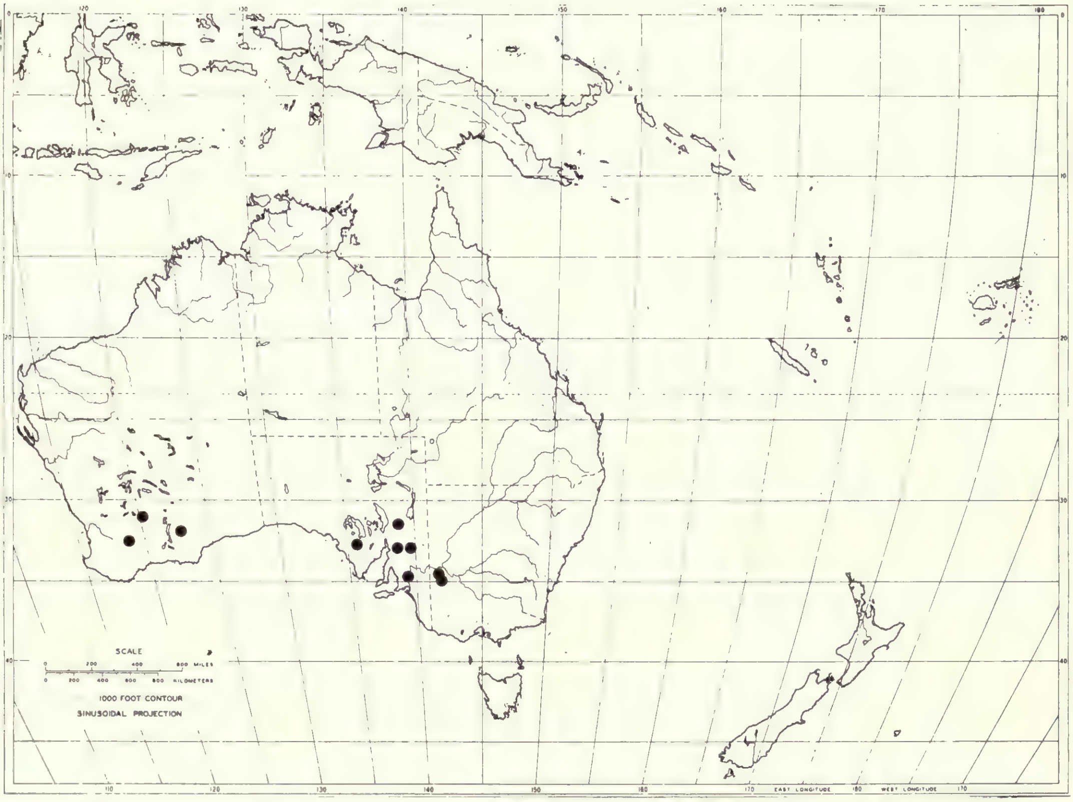
≡ *Parmelia subdistorta* Kurok. in *J. Hattori bot. Lab.* **32**: 212 (1969). Type: Australia, Victoria, 10 km west of Red Cliffs along the Werrimull Road, on soil, *c.* 50 m, *S. Kurokawa* 6617 (TNS – holotype; M! – isotype).

Illustration: Kurokawa (op. cit.).

DESCRIPTION. *Thallus* foliose, moderately to loosely adnate on soil or pebbles, pale yellow-green, 6–10 cm diam.; *lobes* at margins sublinear-elongate, to 1 mm wide, imbricate; secondary lobes overgrowing centre of thallus, narrower than marginal lobes, 0·3–0·5(−0·7) mm wide, revolute, dichotomously divided. *Upper surface* minutely rugulose, strongly convex, emaculate, lacking soredia and isidia, lobe apices often blackened; medulla white. *Lower surface* brown to dark brown but darkening to dark greyish-brown at apices, sparsely rhizinate, rhizines simple, brown. *Apothecia* rare, sessile, 2–5 mm diam., disc pale to dark brown, margin thick, revolute; spores 10 × 7 μm.

CHEMISTRY. Thallus K−; medulla K−, C−, KC+ rose, P−; containing usnic acid, loxodin, norlobaridone.

DISTRIBUTION. Southern Australia (Vic, SA, WA). Map 96. On soil in mallee scrub and arid shrubland. Specimens examined: 25.



Map 96 Distribution of *Xanthoparmelia subdistorta* in Australia.

NOTES. This species may be confused with some forms of *Xanthoparmelia australiensis* because both species have revolute lobes, a pale lower surface, and produce usnic acid, loxodin, and norlobaridone. However, *X. subdistorta* differs in having narrower, revolute lobes (0·3–1·0 mm wide compared with 1·0–3·5 mm), and usually forms rosettes, while *X. australiensis* is often convolute, being loose and scattered on the substrate. *X. subdistorta* also resembles *X. terrestris* and *X. molliuscula* (members of the *X. versicolor* group). However, *X. subdistorta* has a dark brown lower surface and lacks lobules, while *X. terrestris* and *X. molliuscula* have a pale brown to tan lower surface and develop lobules centrally.

X. subdistorta also appears to be closely related to *X. eilifii*; the discrimination of these species is discussed under *X. eilifii*.

X. subdistorta is scattered on soil in subarid and arid areas where common associates include *Psora decipiens* (Hedwig) Hoffm., *Diploschistes scruposus* (Schreber) Norman, *Chondropsis semiviridis* (Nyl.) Nyl., *Xanthoparmelia reptans, X. bellatula,* and *X. terrestris*.

97. **Xanthoparmelia subdomokosii** (Hale) Hale

in *Phytologia* **28**: 489 (1974).

≡ *Parmelia subdomokosii* Hale in *Bot. Notiser* **124**: 353 (1971). Type: South Africa, Cape Province, Distr. Swellendam, 11 km W. of Heidelberg, small hill exposed to the sun, 12 June 1929, *O. A. Höeg* (LD – holotype, US! – isotype).

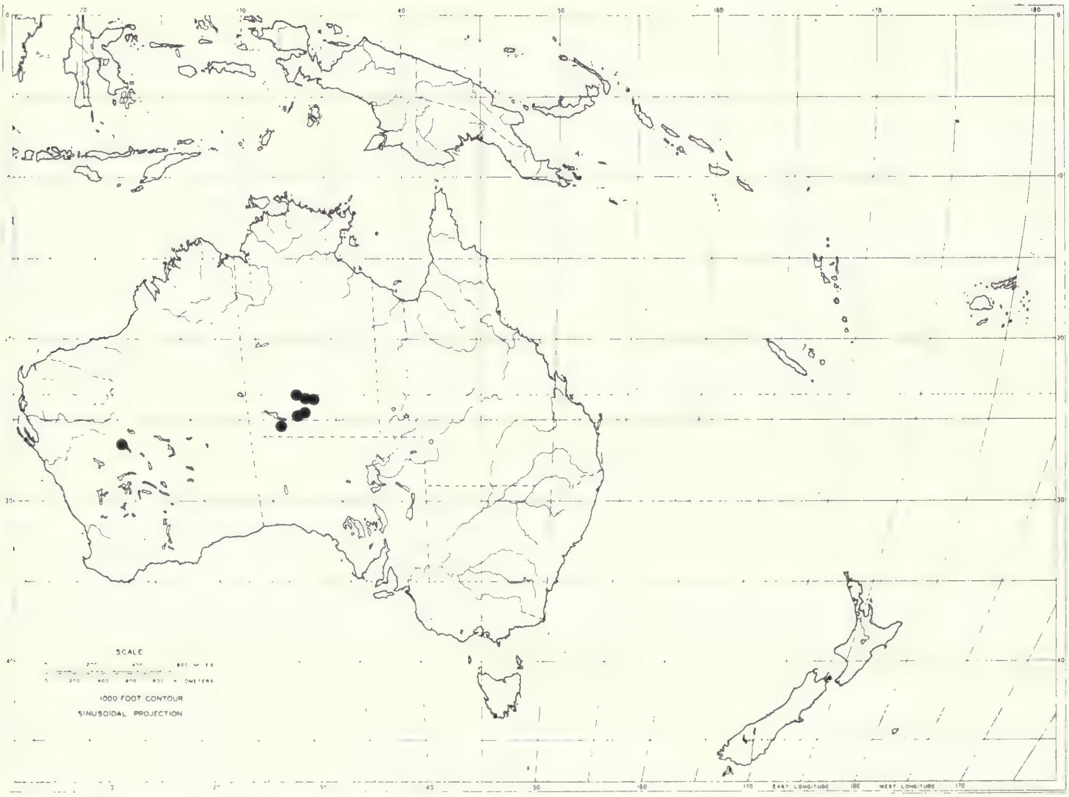
Illustration: Hale (op. cit.).

DESCRIPTION. *Thallus* foliose, adnate, saxicolous, pale yellow-green, subirregularly lobate, 5–7 cm diam.; *lobes* sublinear-elongate to subirregular, contiguous or slightly imbricate, apices ± rotund, 1·0–2·5(–4) mm wide. *Upper surface* flat, shiny, emaculate, often tangentially or irregularly cracked, older lobes becoming rugulose and ± areolate, often with black margins, lacking soredia and isidia; medulla white. *Lower surface* pale brown to brown, moderately to sparsely rhizinate, rhizines simple, concolorous with lower surface or dark-brown, slender. *Apothecia* common, 1–2(–8) mm diam., disc dark brown to black, margin inrolled at first, then thin, entire, exciple smooth; spores 6–8 × 4–5 μm.

CHEMISTRY. Thallus K−; medulla K−, C−, KC−, P−; containing usnic acid and hypoprotocetraric acid, 4-*0*-demethylnotatic acid (± trace).

DISTRIBUTION. Central Australia (WA, NT). Map 97. This species is also known from South Africa. On rocks in arid areas. Specimens examined: 19.

NOTES. Morphologically this species resembles *X. lineola* as both species are characterised by being tightly adnate, and have a pale lower surface, and broad lobes with rotund apices. However *X. lineola* is readily distinguished chemically (salazinic acid present in the medulla), and it tends to have more linear-elongate lobes. A key to this group of species (the *X. lineola* group) is given under *X. lineola*. Chemically *X. subdomokosii* is identical with *X. laxencrustans*



Map 97 Distribution of *Xanthoparmelia subdomokosii* in Australia.

and *X. hypoprotocetrarica*. *X. laxencrustans* is distinguished by the subcrustose growth habit and narrow lobes, while *X. hypoprotocetrarica* is loosely adnate, has a black lower surface, and a maculate upper cortex. By contrast *X. subdomokosii* has broad, adnate lobes, a brown lower surface, and an emaculate upper surface.

In the study area *X. subdomokosii* is restricted to central Australia where it is relatively common on rock ledges with a southerly aspect. It usually co-occurs with *X. cravenii, X. centralis, X. mexicana, X. isidiosa, X. scabrosa*, and *X. weberi*.

98. Xanthoparmelia suberadicata (des Abb.) Hale

in *Phytologia* **28**: 489 (1974).

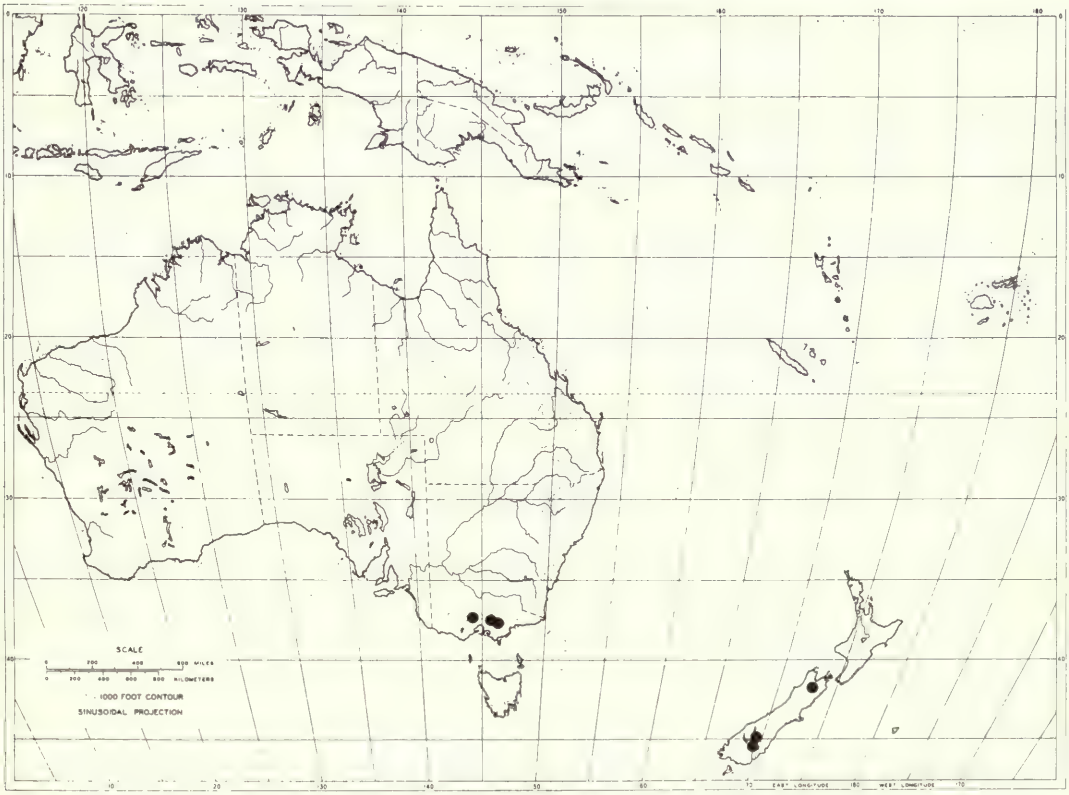
≡ *Parmelia suberadicata* des Abb. in *Mém. Inst. scient. Madagascar* B, **10**: 89 (1961). Type: Madagascar, Centre moyen, route d'Ivato à Ambatofinandrahana, km 12, rochers granitiques un peu ombragés dans une forêt claire à *Uapaca* bojere Baill., 1600 m, *des Abbayes* (RENN – holotype; US! – isotype).

Illustrations: des Abbayes (op. cit.).

DESCRIPTION. *Thallus* foliose, loosely adnate, yellow-green, darkening with age, dichotomously lobate, 4–7 cm diam.; *lobes* narrow, 0·5–1·0(–1·5) mm wide, linear-elongate, dichotomously divided, moderately imbricate, often becoming suberect at apices and exposing black lower surface. *Upper surface* shiny at first, emaculate, with conspicuous black margins, lacking isidia and soredia. *Lower surface* jet black, shiny, wrinkled, sparsely rhizinate or rhizines absent, rhizines black, simple, robust. *Apothecia* not seen.

CHEMISTRY. Thallus K−; medulla K+ yellow, C−, P+ orange; containing usnic acid, stictic acid (major), constictic acid, cryptostictic acid (trace), and norstictic acid (±).

DISTRIBUTION. Rare in Victoria and South Island, New Zealand. Map 98. Also known from Madagascar and South Africa. On rocks in cooler mountain areas. Specimens examined: 8.



Map 98 Distribution of *Xanthoparmelia suberadicata* in Australia and New Zealand.

NOTES. This species belongs to the *X. subnuda* group of species, characterised by narrow, markedly elongate, dichotomously divided lobes, and a black, sparsely rhizinate lower surface. See key under *X. subnuda*.

Chemically *X. suberadicata* is identical with *X. tegeta* and both species have narrow, dichotomously divided lobes with a black lower surface. However, in *X. suberadicata* lobes are not constricted and tend to be markedly linear-elongate and subascending at the apices, while the lower surface is sparsely rhizinate with short, robust, simple rhizines, or else it is erhizinate. In *X. tegeta* the shorter lobes are irregularly constricted, with flat, densely imbricate secondary lobes, and the lower surface is moderately to densely rhizinate with slender, elongated, ± dichotomously divided rhizines.

X. suberadicata is a rare species in the ranges of south-eastern Australia; it grows together with *X. flavescentireagens, X. eradicata,* and *X. tasmanica*.

99. **Xanthoparmelia subnuda** (Kurok.) Hale

in *Phytologia* **28**: 489 (1974).

≡ *Parmelia subnuda* Kurok. in Kurokawa & Elix in *J. Jap. Bot.* **46**: 114 (1971). Type: Australia, New South Wales, Ardglen Gap, Liverpool Range, 8 km south of Murrurundi, on rocks, *S. Kurokawa* 5178 (TNS – holotype).

Illustration: Kurokawa & Elix (op. cit.); Galloway in *N.Z. Jl Bot.* **18**: 543 (1981).

DESCRIPTION. *Thallus* foliose, loosely adnate on rocks, yellowish-green, 4–7 cm diam.; *lobes* sublinear-elongate, di- to trichotomously branched, imbricate, often ascending at apices, 0·3–1·0 mm wide. *Upper surface* smooth, glossy or opaque, weakly maculate or not so, often blackened at margins, lacking soredia and isidia; medulla white. *Lower surface* black, naked, or sparsely rhizinate, rugulose, rhizines simple, black, robust, 0·2–1·0 mm long. *Apothecia* subsessile, 2–10 mm diam., margin undulate or not, disc dark brown, exciple smooth, emaculate; spores 7–8 × 5 μm.

CHEMISTRY. Thallus K−; medulla K+ yellow then red, C−, KC−, P+ yellow; containing usnic acid, norstictic acid (major), connorstictic acid, salazinic acid (±).

DISTRIBUTION. Southern and eastern Australia (Qld, NSW, ACT, Vic, Tas, SA, WA) and South Island, New Zealand (NW Nelson, Central Otago). Map 99. On rocks in drier mountain and subarid areas. Specimens examined: 81.

NOTES. *Xanthoparmelia subnuda* belongs to a group of species (the *X. subnuda* group) characterised by narrow, linearly-elongate lobes which are di- or trichotomously divided, often subascending at apices; the lower surface is black, naked or sparsely rhizinate and rugulose. This group includes *X. multipartita, X. dichotoma, X. eradicata,* and *X. suberadicata*, and these species are most reliably distinguished chemically. In morphology *X. subnuda* closely resembles *X. eradicata* and *X. multipartita*, and the status of these taxa is discussed under the latter. A key to this group of species is given below.

Key to the *Xanthoparmelia subnuda* group in Australasia

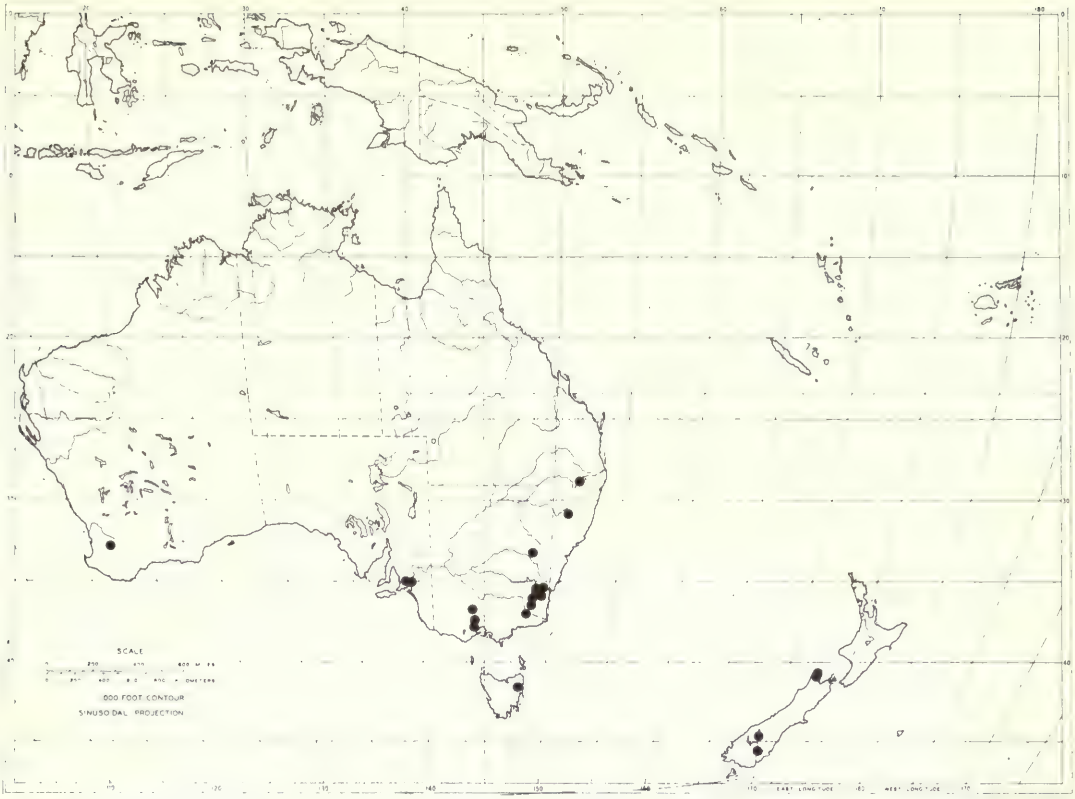
Thallus loosely adnate, lobes linear-elongate, di- or trichotomously divided, lacking soredia and isidia; lower surface black, sparsely rhizinate.

1a. Medulla P+ yellow or yellow-orange 2
1b. Medulla P− 5

2a(1a). Medulla K+ yellow (stictic, constictic acids). In cooler areas........ **98. X. suberadicata** (p. 329)
2b. Medulla K+ yellow-red 3

3a(2b). Lobes flat, densely imbricate, forming a thick mat; lower surface smooth (salazinic acid) .... **17. X. cheelii** (p. 208)
3b. Lobes subascending at apices, ± imbricate but not mat-forming 4

4a(3b). Widespread in dry areas (norstictic [major], connorstictic acids, ± salazinic acid) .... **99. X. subnuda** (p. 330)



Map 99 Distribution of *Xanthoparmelia subnuda* in Australia and New Zealand.

4b. Restricted to cooler areas of southeastern Australia (salazinic acid) .... **36. X. eradicata** (p. 239)
5a(1b). Medulla K+ yellow-pale red (hypostictic, hyposalazinic acid) .... **71. X. multipartita** (p. 292)
5b. Medulla K− 6
6a(5b). Medulla KC+ rose (loxodin, norlobaridone) .... **28. X. dichotoma** (p. 226)
6b. Medulla KC− (scabrosin derivatives) .... **91. X. rupestris** (p. 319)

X. subnuda is a common species in the more temperate areas of southern Australia, but is rather rare in South Island, New Zealand. It favours rocks in open situations and is often be found together with *Cladia aggregata* (Swartz) Nyl., *Xanthoparmelia amplexula, X. furcata, X. notata, X. glareosa*, and *X. tasmanica*.

100. Xanthoparmelia substrigosa (Hale) Hale

in *Phytologia* **28**: 489 (1974).
≡ *Parmelia substrigosa* Hale in Weber, *Lich. Exs.* 338 (1971).
≡ *Parmelia conspersa* var. *strigosa* Müll. Arg. in *Bull. Herb. Boissier* **4**: 90 (1896). Type: Australia, Victoria, Beechworth, 1881, *Falck* 12 (G! – holotype).
Illustration: Galloway in *N.Z. Jl Bot.* **18**: 544 (1981).

DESCRIPTION. *Thallus* foliose, loosely adnate on rocks and soil, yellow-green, 7–12 cm diam.; *lobes* irregular to linear-elongate, subdichotomously or irregularly divided, subascending or not, rarely imbricate, margins broadly sinuate, 1·5–4(–5) mm wide. *Upper surface* shiny but becoming opaque and darkening with age, emaculate, commonly with black margins, lacking soredia and isidia but with numerous pycnidia; medulla white. *Lower surface* pale brown to dark blackish-brown, with dense, brush-like rhizines, rhizines brown to black, simple or often dichotomously branched. *Apothecia* substipitate, large, 8–12 mm diam., the disc dark brown, concave at first, becoming flattened or slightly convex, margin entire, undulating; spores 8–10 × 4–6 μm.

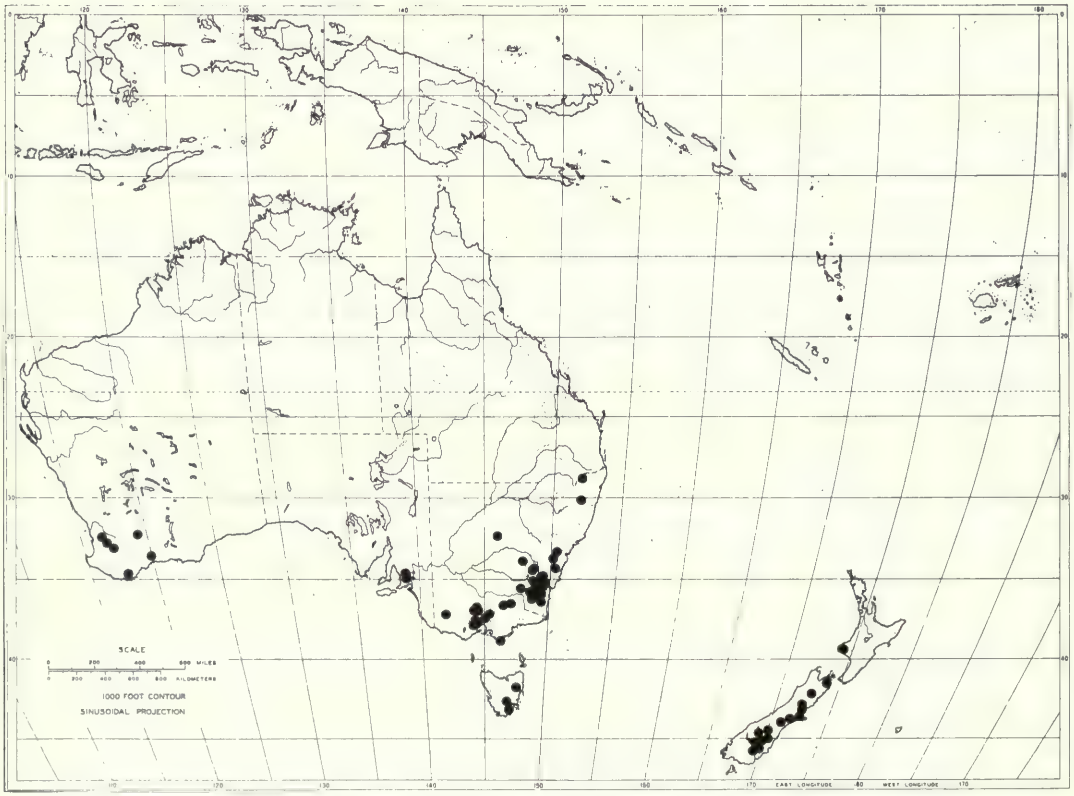
CHEMISTRY. Thallus K−; medulla K+ yellow-red, C−, P+ orange; containing usnic acid, norstictic acid (major), connorstictic acid, salazinic acid (±), consalazinic acid (±).

DISTRIBUTION. Southern and eastern Australia (Qld, NSW, ACT, Vic, Tas, SA, WA) and both islands of New Zealand (in particular Canterbury, Otago). Map 100. On rocks, pebbles, and spreading over soil in lowland, tableland, and mountain areas. Specimens examined: 224.

NOTES. This species is characterised by the loosely adnate thallus, broadly sinuate lobes, and very thick, brush-like rhizines. The lower surface varies from pale brown in older lobes to black-brown, and it is one of the few species of *Xanthoparmelia* to have numerous, dichotomously branched rhizines. It closely resembles *X. metastrigosa*, but the two species are separated clearly by their chemical constituents; *X. metastrigosa* contains usnic, hypostictic, hyposalazinic, and hypoconstictic acids, while *X. substrigosa* contains usnic, norstictic, connorstictic, and ± salazinic acids. Furthermore, the upper surface is convex in *X. metastrigosa*, but flat in *X. substrigosa*.

X. substrigosa may also be confused with *X. barbellata* and *X. glareosa* because both have dichotomously branched rhizines and contain usnic, norstictic, connorstictic, and salazinic acids. However, *P. glareosa* has a black lower surface and is only moderately rhizinate, while *X. barbellata* has a pigmented lower medulla (skyrin).

X. substrigosa is a common and variable species in the ranges of southern Australia, and in drier areas of South Island, New Zealand. Particularly fine growth is observed on expanses of flat, exposed rock surfaces in subalpine areas, while in drier places *X. substrigosa* is often found growing along grooves in rock surfaces which channel run-off water. Depauperate specimens



Map 100 Distribution of *Xanthoparmelia substrigosa* in Australia and New Zealand.

are found in drier environments. *X. substrigosa* is often associated with *Cladia aggregata* (Swartz) Nyl., *Xanthoparmelia dichotoma, X. flavescentireagens, X. furcata, X. scabrosa, X. taractica,* and *X. tasmanica.*

101. **Xanthoparmelia succedans** Elix & Jen Johnston, **nom. nov.**

≡ *Parmelia adpressa* Krempelh. in *Flora, Jena* **59:** 72 (1876), non *Parmelia appressa* Sprengel, *Mantissa Prima Flor. Halens.*: 58 (1807) (Art. 64.2). Type: Brazil, Rio de Janeiro, *A. Glaziou* 3842 (M! – holotype). Illustration: Fig. 35.

DESCRIPTION. *Thallus* foliose, moderately to tightly adnate on rocks, yellow-green, darkening to olive-green or blackish with age, forming patches to 10 cm diam.; *lobes* elongate, not or hardly imbricate, irregularly crowded, 2–2·5(–3·0) mm wide. *Upper surface* smooth or rugulose, opaque but shining and black-margined towards apices, without maculae or soredia, isidiate, *isidia* slender, cylindrical, simple or becoming extensively branched, sparse to moderate, often covering centre of thallus; medulla white. *Lower surface* pale tan to brown, moderately rhizinate, rhizines simple, concolorous with lower surface or blackening and ± tufted. *Apothecia* rare, adnate, 2–4 mm diam., disc dark brown, concave and then flat or nearly so, ± with

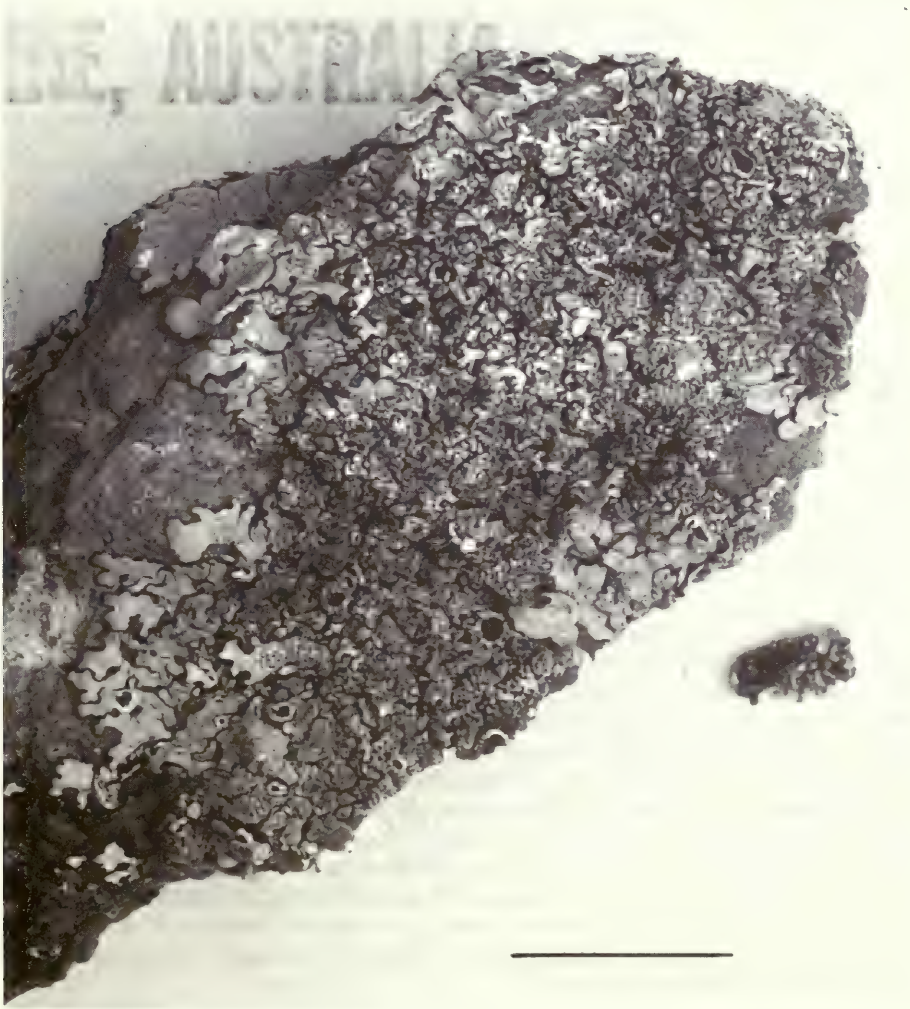
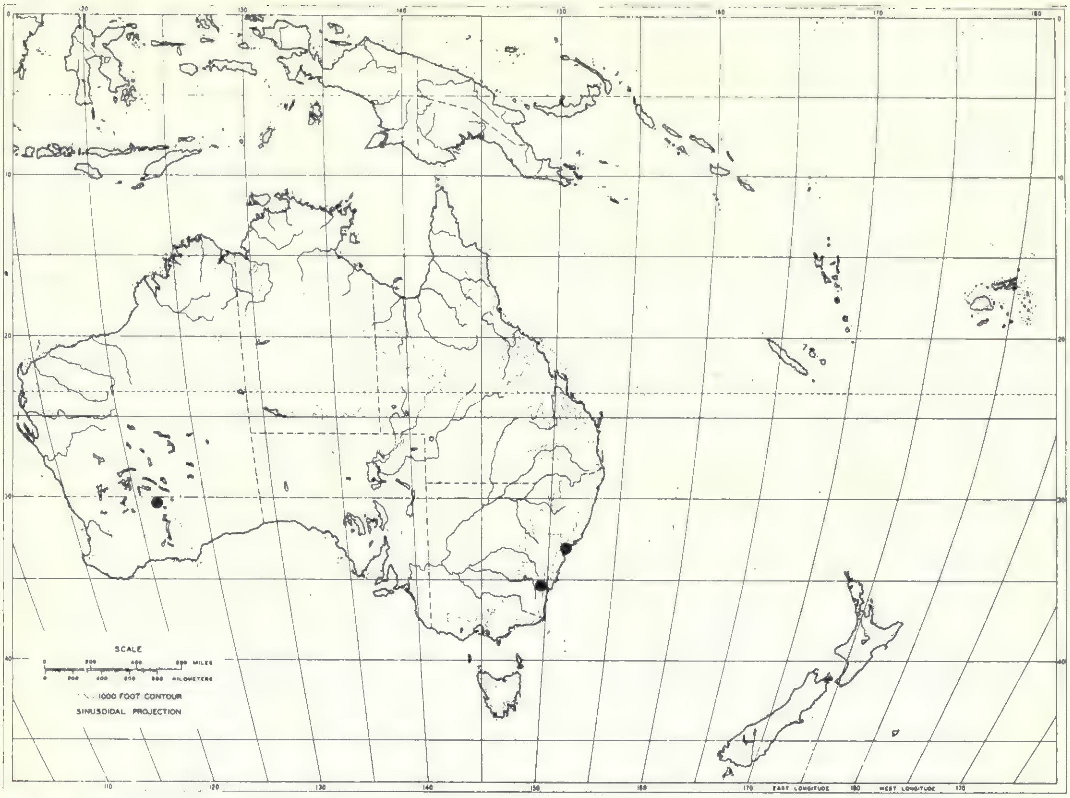


Fig. 35 *Xanthoparmelia succedans* Elix & Jen Johnston. *Malcolm & Collins* MEL 1019022. Scale = 1 cm.



Map 101 Distribution of *Xanthoparmelia succedans* in Australia.

stellate cracks, margin thick and involute at first, persistent, becoming undulate, exciple isidate; spores 7–9 × 4–5·5 μm.

CHEMISTRY. Thallus K−; medulla K+ yellow, C−, KC−, P+ yellow-orange; containing usnic acid, stictic acid (major), constictic acid (minor), salazinic acid (minor), and traces of norstictic acid and cryptostictic acid.

DISTRIBUTION. Rare in southern Australia (NSW, WA). Map 101. Also in South America (Brazil). On rocks in coastal ranges and subarid areas. Specimens examined: 5.

NOTES. *Xanthoparmelia succedans* closely resembles the North American species *X. plittii*; both have similar thalli with a pale brown lower surface, both are isidiate, and both contain the stictic acid complex. The Australian species differs in having somewhat narrower, more tightly adnate lobes; the isidia are more slender and highly branched, and are only rarely slightly inflated at the apices. By contrast the American species has sparse to moderate, globose isidia which are inflated at the apices and sparingly branched, and its lobes are broader (2·5–5·0 mm wide cf. 2·0–2·5 mm) and less adnate. In addition, the medulla of *X. succedans* always contains minor but significant quantities of salazinic acid in addition to the stictic acid complex – an uncommon combination of β-orcinol depsidones. Salazinic acid is not known in North American material.

This species also resembles *X. mexicana* in that both have thalli with a pale brown lower surface and are isidiate. However, *X. succedans* has more elongate, scarcely imbricate lobes, with simple, scattered isidia, and contains usnic acid and the stictic acid complex, while *X. mexicana* has broader, congested and imbricate lobes with dense isidia which become coralloid, and contains usnic acid and salazinic acid.

X. succedans is rare in Australia, and associates with *X. antleriformis, X. mexicana, X. neotinctina*, and *X. adhaerens*.

102, Xanthoparmelia sulcifera (Kurok.) Hale

in *Mycotaxon* **20**: 79 (1984).

≡ *Parmelia sulcifera* Kurok. in *Bull. natn. Sci. Mus. Tokyo* B, **8**: 37 (1982). Type: Australia, New South Wales, 15 km east of Cooma on Numeralla Road, *c.* 850 m, *S. Kurokawa* 6450 (TNS – holotype; ANUC! – isotype).

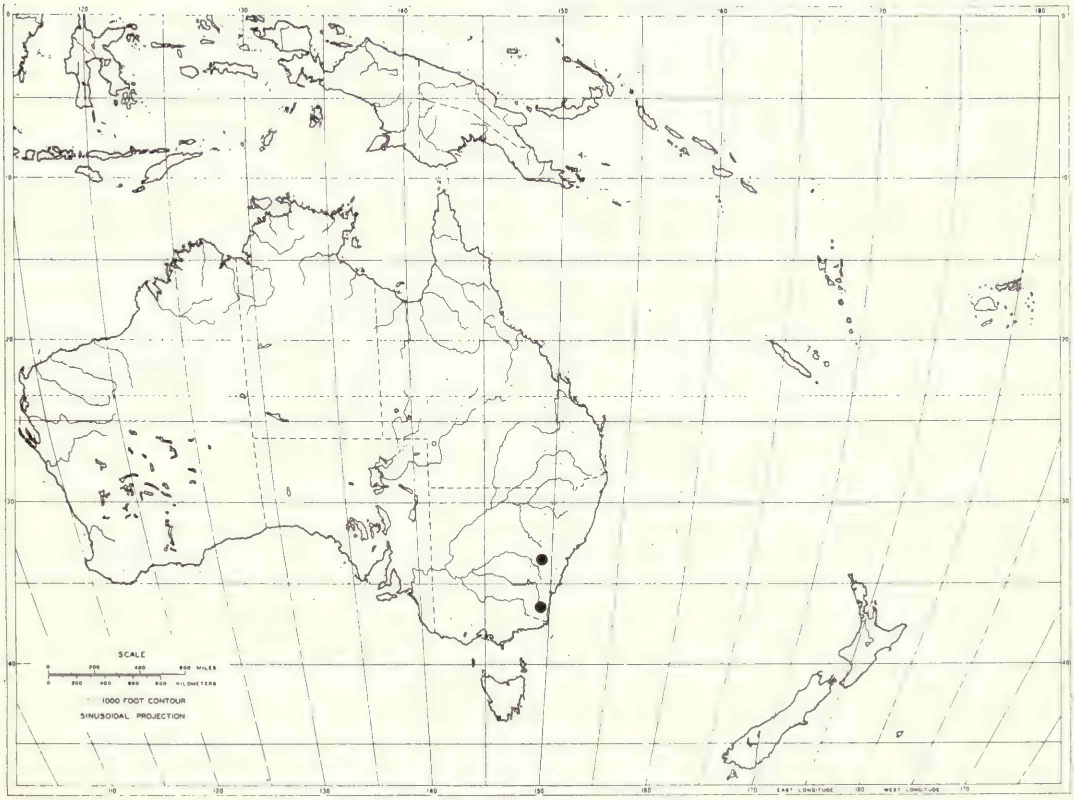
Illustration: Kurokawa (op. cit.).

Description. *Thallus* foliose, loosely adnate on soil, rarely on rocks, pale yellow-green, forming loosely disjointed patches to 6 cm diam.; primary *lobes* tightly adnate, irregularly branched, imbricate or not, 0·7–2·0 mm wide, secondary lobes revolute to convolute, subdichotomously divided, 0·3–0·5(–1·0) mm wide, often entangled and growing over primary lobes, ± subascending at apices. *Upper surface* dull, emaculate, smooth to slightly rugulose, convex, lacking soredia and isidia, often developing blackened margins towards lobe apices; medulla white. *Lower surface* straw-yellow to pale brown, usually dark brown or black towards apices, ± canaliculate, sparsely to moderately rhizinate, rhizines simple or tufted, often grouped subapically, concolorous with lower surface, 0·2–0·6 mm long. *Apothecia* rare, substipitate, 1·0–3·0 mm diam., disc red to dark brown, concave, margin thick, involute, ± undulate, exciple smooth; spores 10–11 × 4–6 μm.

Chemistry. Thallus K−; medulla K− or K+ pale reddish, C−, K−, P−; containing usnic acid, hypostictic acid, hyposalazinic acid, and hypoconstictic acid (±).

Distribution. Central and southern tablelands of NSW. Map 102. On soil and pebbles in dry tableland areas. Specimens examined: 8.

Notes. *Xanthoparmelia sulcifera* belongs to the *X. versicolor* group of species, characterised by the terricolous habit and the production of revolute secondary lobes with a canaliculate lower



Map 102 Distribution of *Xanthoparmelia sulcifera* in Australia.

surface. Like *X. terrestris, X. sulcifera* is commonly subpulvinate, forming subfruticose cushions with entangled lobes which grow in disjointed patches on soil. However, *X. terrestris* differs chemically (usnic, norstictic, and salazinic acids), it is more sparsely rhizinate, and has a pale brown lower surface throughout. The lower surface of *X. sulcifera* darkens towards the apices and the rhizines are dense in this region. For further discussion and a key to this group of species see under *X. versicolor*.

In some growth forms *X. sulcifera* also resembles the *X. amphixantha* group of species, particularly *X. willisii. X. willisii* differs in being sparsely rhizinate, in lacking tightly adnate primary lobes, and in chemistry (usnic, fumarprotocetraric, and succinprotocetraric acids).

In morphology *X. sulcifera* comes close to the American species *X. wyomingica* (Gyelnik) Hale, although the latter generally has a darker lower surface (brown to brown-black). These species are readily distinguished chemically, since *X. wyomingica* contains salazinic acid, while *X. sulcifera* contains hypostictic and hyposalazinic acids.

X. sulcifera is a rare species on soils in the rain-shadow areas of the central and southern tablelands of New South Wales. Common associates include *Chondropsis semiviridis* (Nyl.) Nyl., *Cladia aggregata* (Swartz) Nyl., *Xanthoparmelia reptans,* and *X. substrigosa*.

103. **Xanthoparmelia taractica** (Krempelh.) Hale

in *Phytologia* **28**: 489 (1974).

≡ *Parmelia taractica* Krempelh. in *Flora, Jena* **61**: 439 (1878). Type: Argentina [Regiones alpinae Andicum, ad terram, inter gramina] 1872–74, leg. *Lorentz & Hieronymus* (Herb. A. v. Krempelhuber) (M! – holotype).

= *Parmelia polyphylloides* (Müll. Arg.) Gyelnik in *Reprium Spec. nov. Regni veg.* **35**: 371 (1934).

≡ *Parmelia conspersa* var. *polyphylloides* Müll. Arg. in *Flora, Jena* **66**: 47 (1883). Type: Australia, South Australia, Fowlers Bay, *Richard* (G! – holotype; MEL 6194! – isotype).

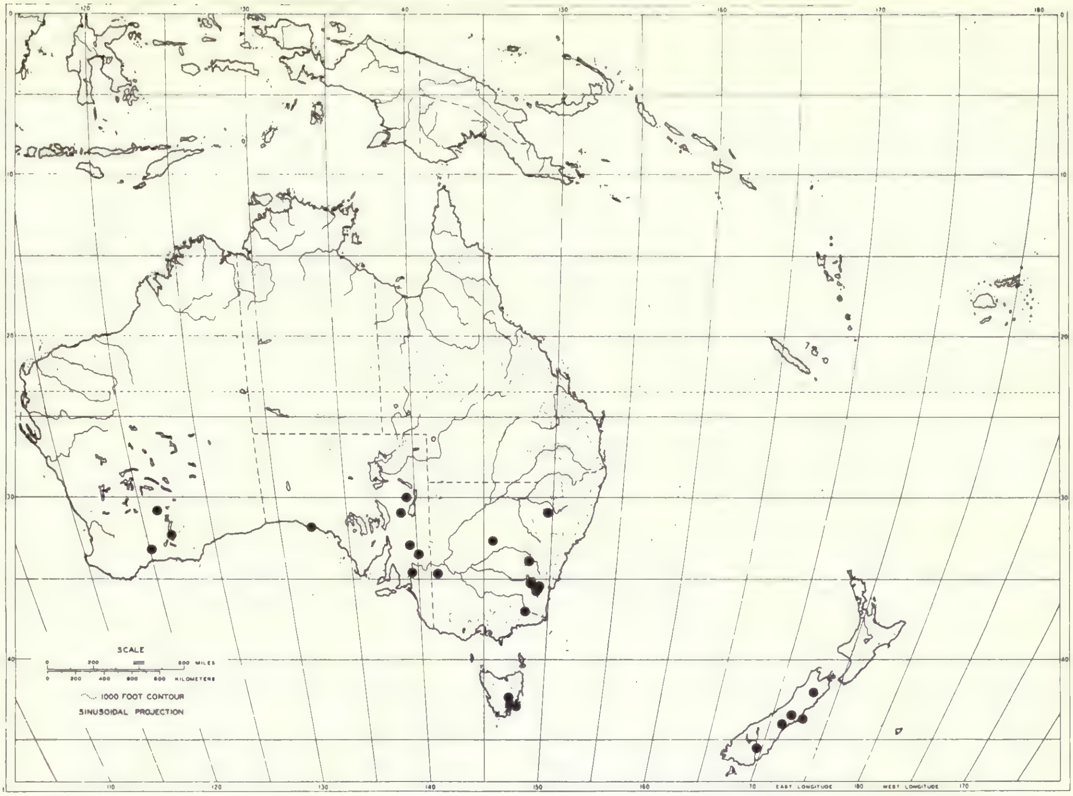
Illustrations: Taylor, *Lichens Ohio* **1**: 99 (1967); Hale, *How to know the lichens,* 2nd ed.: fig. 63 (1979).

DESCRIPTION. *Thallus* foliose, terricolous or saxicolous, moderately to loosely adnate to substrate, yellow-green, darkening with age, 7–10 cm diam.; *lobes* variable, subirregular to linear-elongate, often forming a dense, imbricate mat, with broad primary and marginal lobes with subrotund apices, 2–4(–8) mm wide, sometimes with narrower (0·7–1·5 mm wide), elongated, subdichotomously divided secondary lobes or lobules (*c.* 0·5 mm wide) developing from centre. *Upper surface* shiny, smooth to slightly rugulose, emaculate, becoming ± wrinkled and developing tangential cracks in older lobes, lacking soredia and isidia; medulla white. *Lower surface* pale brown to brown, darker at centre, wrinkled, papillate, often shiny, densely rhizinate especially near the margin, rhizines slender, simple or often tufted, rarely dichotomously branched, concolorous with lower surface. *Apothecia* occasional, sessile, 3–6 mm diam., disc red-brown, concave, becoming plane, margin entire, thick and involute at first, becoming crenulate, exciple rugulose; spores 8–10 × 6 μm.

CHEMISTRY. Thallus K−; medulla K+ yellow becoming red, C−, KC+ red, P+ orange; containing usnic acid, salazinic acid, consalazinic acid.

DISTRIBUTION. This species occurs in the drier areas of Southern Australia (NSW, ACT, Vic, Tas, SA, and WA) and in South Island, New Zealand. Map 103. It is a cosmopolitan species known also from North and South America, Japan, India, and Hawaii. On rocks and soil in drier mountain and subarid lowland areas. Specimens examined: 46.

NOTES. Superficially this species closely resembles *Xanthoparmelia tasmanica* in forming a dense, imbricate mat, with broad, subrotund lobes, containing usnic and salazinic acids. However, the lower surface of *X. taractica* is pale and densely rhizinate, while that of *X. tasmanica* is black and sparsely rhizinate. This species could be confused with *X. digitiformis*, but this has much narrower lobes which are moderately to sparsely rhizinate. The distinctions between these species are discussed in detail under *X. digitiformis*.



Map 103 Distribution of *Xanthoparmelia taractica* in Australia and New Zealand.

X. taractica is a common species in the drier ranges and foothills of southern Australia and South Island, New Zealand, and also on soil in subarid areas of Australia. It often associates with *X. australasica, X. flavescentireagens, X. reptans, X. substrigosa,* and *X. tasmanica*.

104. Xanthoparmelia tasmanica (J. D. Hook. & Taylor) Hale

in *Phytologia* **28**: 489 (1974).

≡ *Parmelia tasmanica* J. D. Hook. & Taylor in *Lond. J. Bot.* **3**: 644 (1844). Type: Australia, Van Diemen's Land (Tasmania), *R. Gunn* (BM – lectotype fide Galloway 1981: 544; FH! – isotype).

= *Parmelia incisa* Taylor in *Lond. J. Bot.* **6**: 162 (1847). Type: Australia, Swan River, 1843, *J. Drummond* (FH – holotype, BM! – isotype).

≡ *Parmelia conspersa* var. *incisa* (Taylor) Zahlbr., *Cat. Lich. Univ.* **6**: 132 (1930).

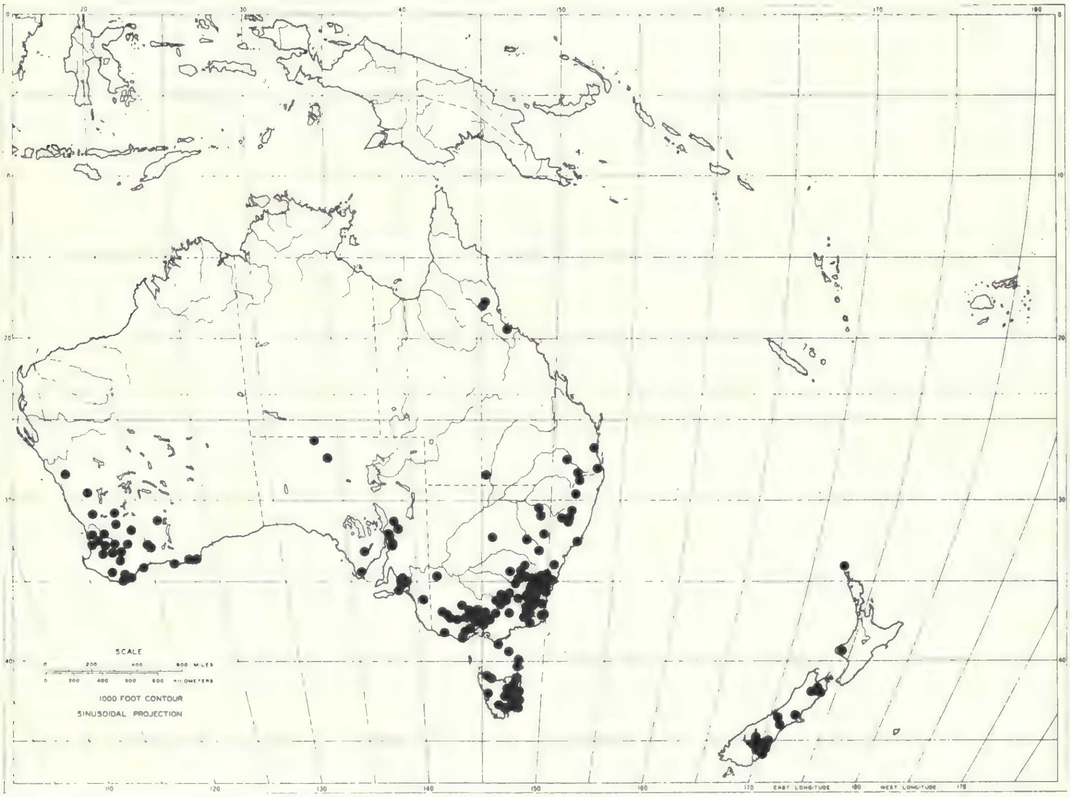
= *Parmelia conspersa* var. *laxa* Müll. Arg. in *Flora, Jena* **66**: 48 (1883). Type: Australia, Victoria, Upper Ovens River, 1882, *McCann* (BM! – isotype).

Illustrations: Filson & Rogers, *Lichens South Australia*: plate 13B, fig. 23C (1979); Hale, *How to know the lichens*, 2nd ed.: fig. 65 (1979); Galloway in *N.Z. Jl Bot.* **18**: 545 (1981).

DESCRIPTION. *Thallus* foliose, saxicolous, rarely terricolous, loosely attached to substrate, yellow-green, or blackening in older lobes, to 15 cm diam.; *lobes* very variable, sometimes narrow, 1·0–2·0 mm wide and sublinear-elongate, more commonly subirregular, 2·0–5·0 mm wide, densely imbricate, often with masses of secondary lobes building up thallus into a thick mat, apices smoothly rounded or shallowly incised. *Upper surface* smooth, shiny, emaculate, lacking soredia and isidia, margins usually slightly thickened, brown or black. *Lower surface* jet black, smooth, brown at lobe apices, sparsely rhizinate, rhizines black, simple, robust. *Apothecia* common, to 15 cm diam., deeply concave to almost plane, margin involute at first, entire or crenulate, exciple smooth, shining; spores 10–11 × 6–7 μm. Pycnidia common, black, minute, punctiform.

CHEMISTRY. Thallus K−; medulla K+ yellow then red, C−, KC−, P+ orange to red; containing usnic acid, salazinic acid, consalazinic acid; rarely with traces of protocetraric acid (±), norstictic acid (±).

DISTRIBUTION. Southern and eastern Australia (Qld, NSW, ACT, Vic, Tas, SA, WA), and New Zealand. Map 104. Also known from North America (U.S.A.) and South Africa. On rocks, rarely on soils in coastal, mountain, subalpine, montane, and subarid habitats. Specimens examined: 539.



Map 104 Distribution of *Xanthoparmelia tasmanica* in Australia and New Zealand.

NOTES. The thallus of this common species is characteristically loosely adnate, with highly imbricate lobes more or less building up into a thick mat; it has a black lower surface, and contains usnic and salazinic acids. Lobe configuration is very variable and those specimens with narrow (1·0–2·5 mm) elongate lobes are often confused with *Xanthoparmelia cheelii*. Lobes in *X. cheelii* are, in fact, narrower (0·5–1·0 mm) and dichotomously divided, while those of *X. tasmanica* are broader (1·0–2·5 mm) and subirregularly divided, but these two species do occasionally appear to intergrade.

X. tasmanica also resembles *X. luminosa* and *X. congesta*, but these two species are more tightly adnate than *X. tasmanica*. Further, *X. luminosa* differs in having a pigmented lower medulla and more rounded lobe apices, while *X. congesta* produces norstictic acid rather than salazinic acid as the major medullary acid.

X. tasmanica is undoubtedly the most common species of *Xanthoparmelia* throughout more temperate areas of southern Australia, but is less common in New Zealand. In Australia virtually all large colonies of *Xanthoparmelia* will contain some representative thalli of *X. tasmanica*.

105. **Xanthoparmelia tegeta** Elix & Jen Johnston, **sp. nov.**

Thallus ut in *Xanthoparmelia constrictanti* sed lobis angustioribus, acidum sticticum et acidum consticticum et acidum norsticticum et acidum cryptosticticum continenti, saepe dense imbricatis tegetem compactam formantibus, differt. Superficies inferior nigra, modice vel dense rhizinata, rhizinis concoloris, simplicibus vel parce ramosis. Thallus 140–160 μm crassus; cortex superior *c.* 17 μm crassus, stratum gonidiale 14–24 μm crassum, medulla 70–95 μm crassa, cortex inferior 10–17 μm crassus. Thallus K−; medulla K+ flavescens, C−, P+ aurantiaca.

Type: Australia, New South Wales, Kosciusko National Park, near Diggers Creek, on exposed granite rocks, 1580 m, 21 January 1976, *J. A. Elix* 1718 (CBG! – holotype; MEL! – isotype).
Illustration: Fig. 36.

DESCRIPTION. *Thallus* foliose, adnate to loosely adnate on rocks, yellow-green, darkening with age, dichotomously to subirregularly lobate, 4–7 cm diam.; *lobes* narrow, 0·3–1·0(–1·5) mm wide, linear-elongate, generally irregularly constricted, secondary lobes often densely imbri-

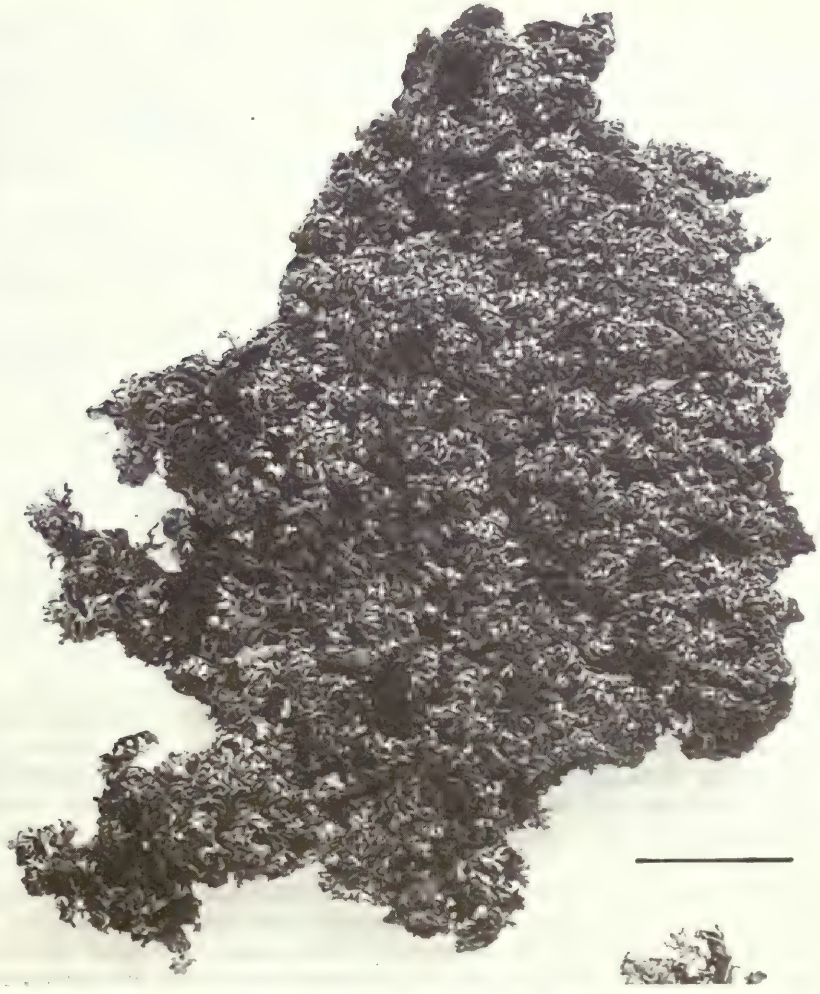
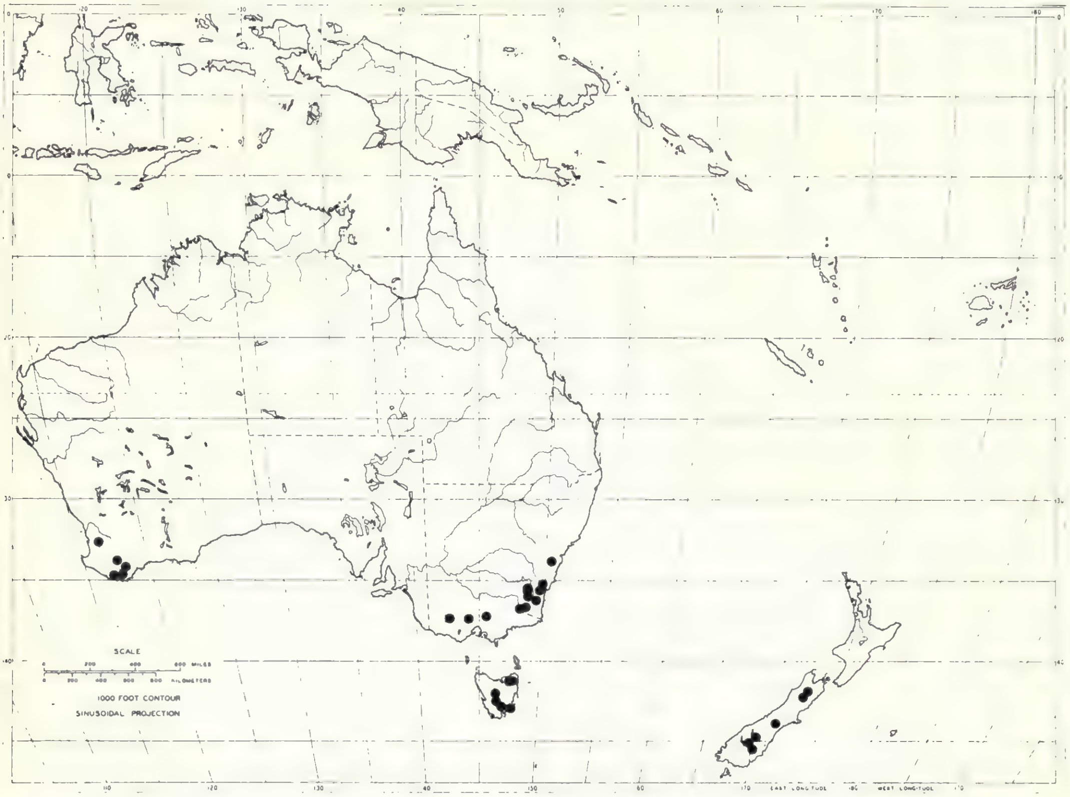


Fig. 36 *Xanthoparmelia tegeta* Elix & Jen Johnston. Holotype in CBG. Scale = 1 cm.

cate, resulting in the formation of a compact mat. *Upper surface* shiny at first, emaculate, with conspicuous black margins, lacking soredia and isidia; medulla white. *Lower surface* black, shiny, moderately to densely rhizinate, rhizines black, simple or rarely dichotomously divided, to 2 mm long, ± projecting beyond the margin, often rhizinate to margin and appearing ciliate. *Apothecia* adnate, rare, 0·5–1·5 mm diam., disc dark brown, exciple smooth; spores 6–9·5 × 3·5–5·5 μm.

CHEMISTRY. Thallus K−; medulla K+ yellow, C−, P+ orange; containing usnic acid, stictic acid (major), constictic acid, and small quantities of norstictic acid and cryptostictic acid.

DISTRIBUTION. Southern Australia (NSW, ACT, Vic, Tas, WA) and South Island, New Zealand. Map 105. Also known from South Africa. On rocks in cooler mountain and subalpine areas. Specimens examined: 52.



Map 105 Distribution of *Xanthoparmelia tegeta* in Australia and New Zealand.

NOTES. Morphologically this species closely resembles *Xanthoparmelia constrictans* in that both species have irregularly constricted linear-elongate lobes which are black below, and have moderately long, slender rhizines. *X. constrictans* is distinguished by the somewhat broader lobes (1·0–2·0 mm wide) and the production of salazinic acid in the medulla. Further, *X. constrictans* rarely forms a compact, densely imbricate mat of secondary lobes so characteristic of *X. tegeta*.

In the latter growth form *X. tegeta* resembles *X. cheelii* but tends to be much more densely rhizinate, and contains stictic acid, constictic acid, and usnic acid, rather than salazinic acid and usnic acid. Some such specimens appear spuriously ciliate, since they have rhizines to the margins which may also project beyond the margins of very narrow lobes. By contrast, primary lobes of *X. tegeta* are usually adnate to the substrate, congested and contiguous but rarely imbricate, develop tangential cracks towards the centre of the thallus, and become ± areolate and blackened.

Chemically *X. tegeta* is identical with *X. suberadicata* and both species have narrow, dichotomously divided lobes with a black lower surface. However, in *X. suberadicata* the lobes are not constricted, tend to be more linearly-elongate and subascending at the apices, and the lower surface is naked or very sparsely rhizinate with short, robust, simple rhizines. In *X. tegeta* the short lobes are irregularly constricted, with flat, densely imbricate secondary lobes, and the lower surface is moderately to densely rhizinate with slender, elongate, ± dichotomously divided rhizines.

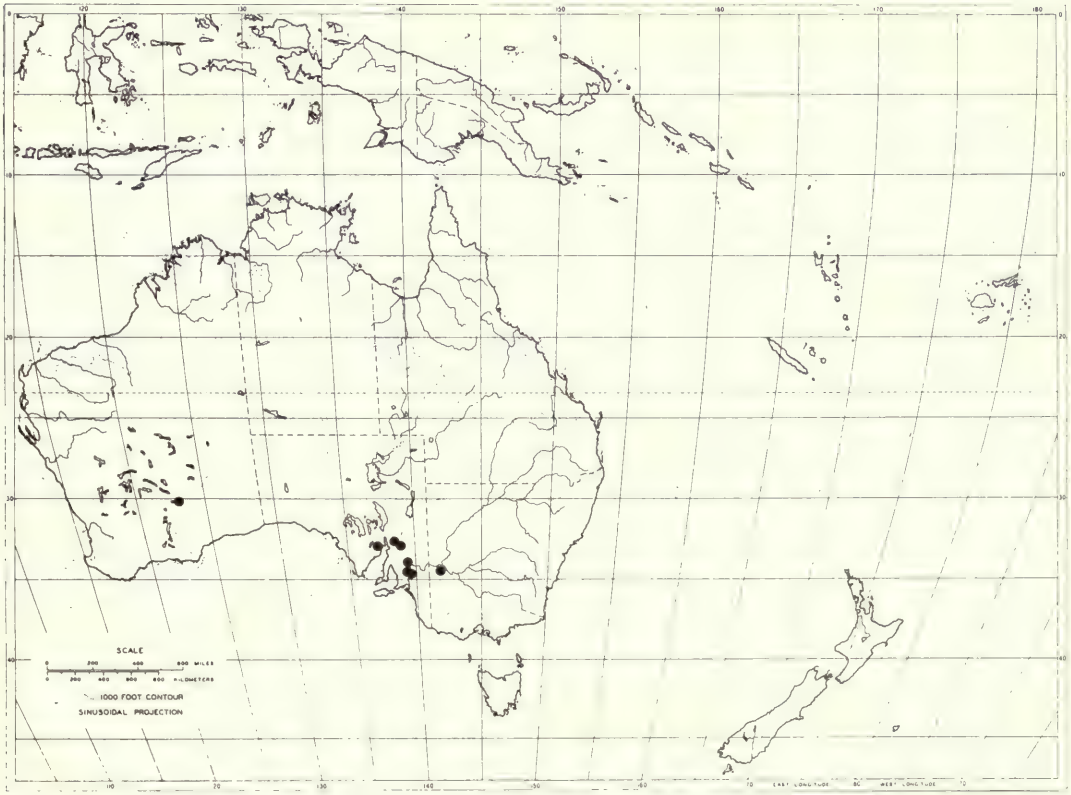
X. tegeta is a relatively common species in the ranges of south-eastern Australia and South Island, New Zealand, preferring open saxicolous habitats, and in Australia it is found together with *Parmelia signifera* Nyl., *Hypogymnia tubularis* (Taylor) Elix, *Cladia aggregata* (Swartz) Nyl., *Xanthoparmelia congesta, X. dichotoma, X. flavescentireagens,* and *X. eradicata*.

106. Xanthoparmelia terrestris (Kurok. & Filson) Elix & Jen Johnston, **comb. nov.**

Basionym: *Parmelia terrestris* Kurok. & Filson in Filson in *Aust. J. Bot.* **30**: 574 (1982). Type: Australia, Victoria, 10 km west of Red Cliffs along the Werrimull road, *c.* 50 m, 8 December 1965, *S. Kurokawa* 6615 (TNS – holotype; Mel 1522911! – isotype).

Illustration: Filson (op. cit.).

DESCRIPTION. *Thallus* foliose, loosely attached to soil or debris, pale yellow-green, forming loosely disjointed patches to 10 cm diam.; *lobes* elongate, subdichotomously divided, revolute to convolute, 1·0–2·0 mm wide, often entangled, secondary lobes narrower, 0·3–0·5 mm wide, often growing over primary lobes or occasionally becoming subterete, coralloid, isidia-like,



Map 106 Distribution of *Xanthoparmelia terrestris* in Australia.

growing up from lobules in centre of thallus. *Upper surface* dull, smooth to slightly rugulose, convex, lacking soredia, isidia and maculae; medulla white. *Lower surface* whitish to pale brown, sparsely to moderately rhizinate, rhizines simple, concolorous with lower surface. *Apothecia* occasional, to 2 mm diam., adnate, disc brown, smooth, concave, margin thick, crenulate; spores 8–10 × 6–7 μm.

CHEMISTRY. Thallus K−; medulla K+ yellow becoming red, C−, P+ yellow becoming orange; containing usnic acid, norstictic acid (major), salazinic acid, connorstictic acid.

DISTRIBUTION. Murray mallee (SA, Vic) and arid shrubland (Eyre Pen., WA). Map 106. On soil in mallee scrub and arid shrubland. Specimens examined: 33.

NOTES: This terricolous species is characterised by elongate revolute lobes and the presence of terete lobules; it belongs to the *X. versicolor* group. Chemically and morphologically *X. terrestris* is closely related to *X. alternata* and *X. versicolor*, but *X. versicolor* is distinguished by its black lower surface and broad marginal lobes. Furthermore, while *X. alternata* grows more or less flat on soil and has revolute lobes, *X. terrestris* often forms subpulvinate clumps on soil and has terete or subterete lobules. In addition, *X. versicolor* and *X. alternata* contain salazinic acid as the major medullary metabolite, while norstictic acid predominates in *X. terrestris*.

X. terrestris could be considered to be related to *X. elixii* as these two species are loosely adnate, have pale to brown lower surfaces, and produce usnic, norstictic, and salazinic acids. However, lobes in *X. terrestris* are usually convex above and more or less canaliculate below, whereas those of *X. elixii* are flat and never canaliculate. *X. terrestris* closely resembles *X. molliuscula*; see the latter for the distinctions between these taxa.

X. terrestris is scattered and locally common on soil in subarid and arid areas; common associates include *Psora decipiens* (Hedwig) Hoffm., *Diploschistes scruposus* (Schreber) Norman, *Chondropsis semiviridis* (Nyl.) Nyl., *Xanthoparmelia reptans, X. versicolor*, and *X. subdistorta*.

107. **Xanthoparmelia thamnoides** (Kurok.) Hale

in *Phytologia* **28**: 489 (1974).

≡ *Parmelia thamnoides* Kurok. in *J. Hattori bot. Lab.* **32**: 213 (1969). Type: Australia, Queensland, Freshwater Gorge, NW. of Cairns, *S. Kurokawa* 5723 (TNS – holotype; MEL 1013465! – isotype).

Illustrations: Kurokawa (op. cit.); Galloway in *N.Z. Jl Bot.* **18**: 547 (1981).

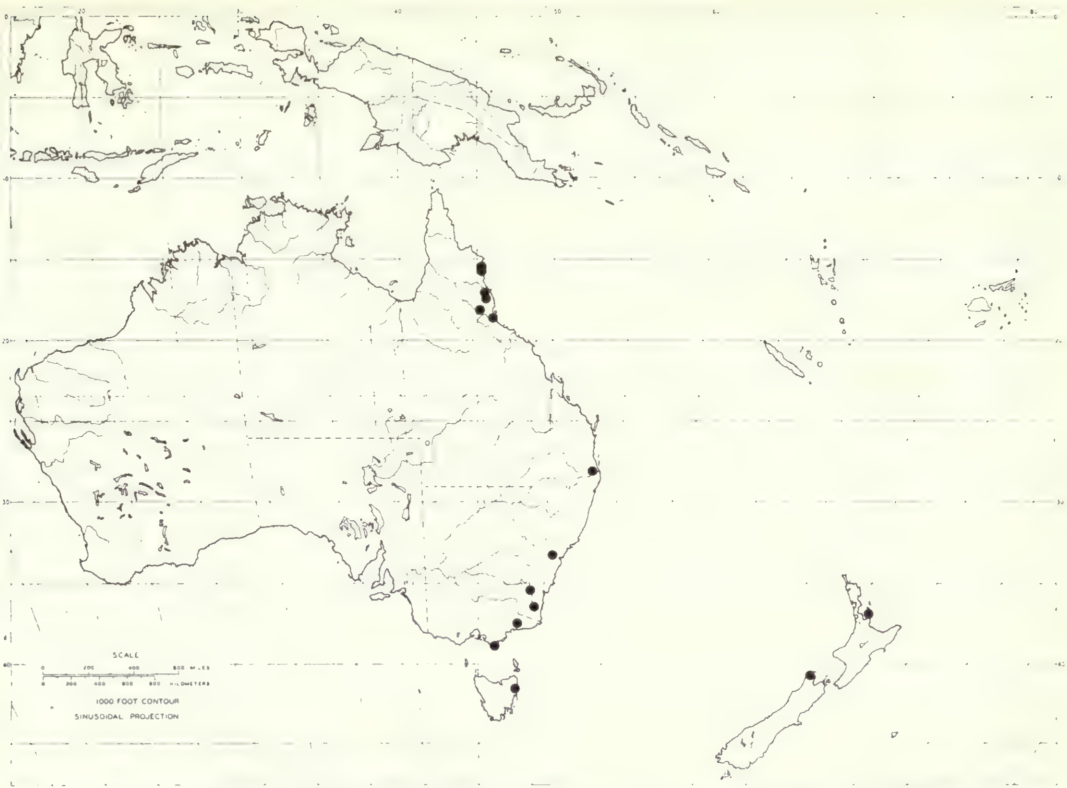
DESCRIPTION. *Thallus* foliose, adnate to the substrate, yellow-green, often blackened centrally, 5–10 cm diam.; *lobes* irregular, sublinear-elongate, imbricate or not, 2–4 mm wide, margins incised, slightly thickened and black. *Upper surface* smooth, emaculate, coriaceous, conspicuously wrinkled and irregularly cracked in older parts, lacking soredia, isidiate, *isidia* laminal, rarely at lobe apices, slender, simple, cylindrical becoming coralloid-branched, brownish at apices; medulla white. *Lower surface* black, shining, moderately rhizinate, rhizines simple, black. *Apothecia* not seen.

CHEMISTRY. Thallus K−; medulla K−, C−, KC+ rose, P−; containing usnic acid, loxodin (±) and norlobaridone, conorlobaridone (±), scabrosin 4-acetate-4′-butyrate (±), scabrosin 4-acetate-4′-hexanoate (±), scabrosin 4,4′-dibutyrate (±).

DISTRIBUTION. Eastern and southern Australia (Qld, NSW, Vic, Tas) and New Zealand. Map 107. Except in north Queensland this species is rather rare throughout its range of distribution. On rocks in moist forests. Specimens examined: 23.

NOTES. This is a distinctive species, characterised by the adnate, coriaceous thallus, the presence of coralloid-cylindrical isidia, the black lower surface, and the production of usnic acid, loxodin, and norlobaridone.

The presence of cylindrical isidia and production of loxodin and norlobaridone are reminiscent of *Xanthoparmelia amplexula*, but the latter species is more loosely adnate and has a pale tan to brown lower surface. In morphology this species resembles *X. isidiigera* but differs in the



Map 107 Distribution of *Xanthoparmelia thamnoides* in Australia and New Zealand.

nature of the isidia and the medullary chemistry. *X. isidiigera* has scattered, mainly simple isidia, and produces usnic and salazinic acids.

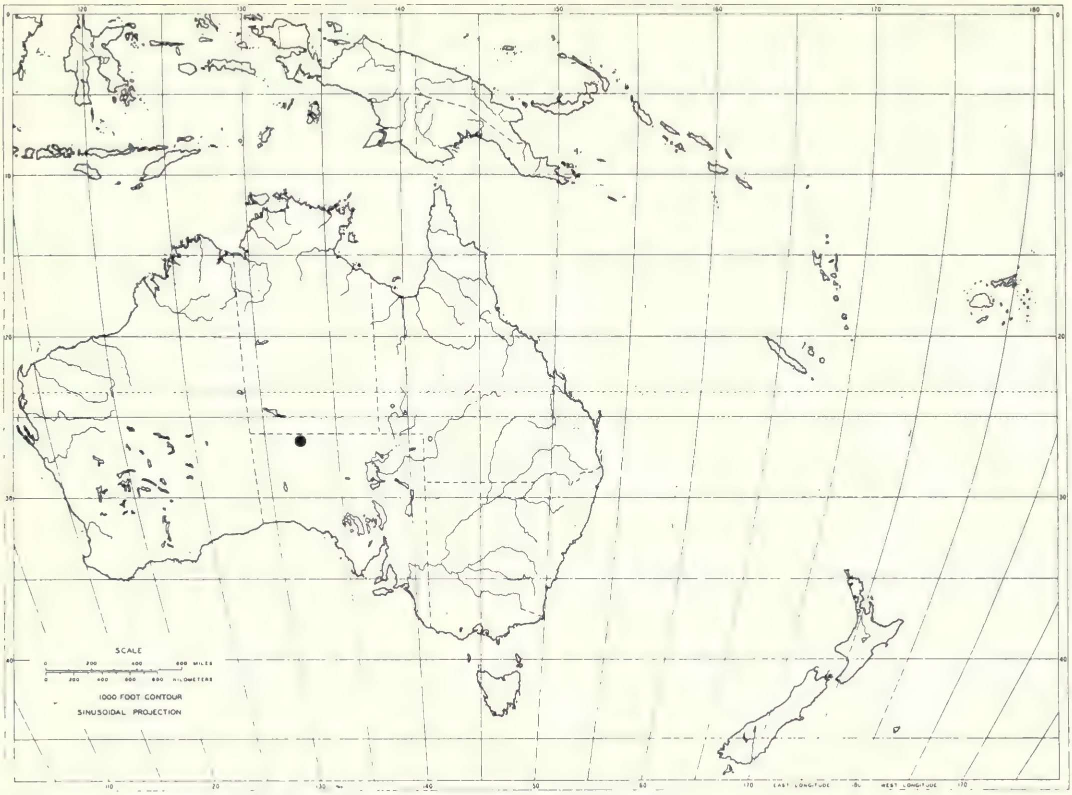
X. thamnoides prefers moist, saxicolous habitats, and grows in association with *Cladia aggregata* (Swartz) Nyl., *Xanthoparmelia amplexula, X. furcata, X. flavescentireagens,* and *X. tasmanica*.

108. **Xanthoparmelia tucsonensis** (T. Nash) Egan

in *Mycotaxon* **2**: 218 (1975).
≡ *Parmelia tucsonensis* T. Nash in *Bryologist* **77**: 234 (1974). Type: U.S.A., Arizona, Pima Co., on volcanic rock W. side of Tucson Mountains on a NW. slope above St Mary's Road, 910 m., *T. H. Nash* 6203 (Herb. Arizona State Univ.! – holotype).
Illustration: Nash (op. cit.).

DESCRIPTION. *Thallus* foliose, adnate to tightly adnate on rocks, 4–7 cm wide, yellow-green, *lobes* subirregular, contiguous, 0·7–2·0 mm wide, becoming irregularly buckled and distorted, older lobes irregularly fractured and areolae commonly formed. *Upper surface* dull, shiny towards lobe apices, older lobes with tangential or irregular cracks, lacking soredia and isidia; medulla white. *Lower surface* pale brown to brown, moderately rhizinate, rhizines concolorous with lower surface, simple. *Apothecia* numerous, adnate, 1–3 mm diam., disc dark brown, margin entire; spores 7·0–9·0 × 3·5–5·5 μm.

CHEMISTRY. Thallus K−; medulla K−, P−, C−, KC−; containing usnic acid, diffractaic acid (major) and traces of barbatic acid, 4-*O*-demethylbarbatic acid, 3-α-hydroxybarbatic acid (±) and squamatic acid (±), constipatic acid (±), protoconstipatic acid (±).



Map 108 Distribution of *Xanthoparmelia tucsonensis* in Australia.

Distribution. Northern SA (Musgrave Range). Map 108. Known also from Mexico, Arizona (USA). On rocks in arid areas. Specimens examined: 4.

Notes. Three non-isidiate Australasian species produce diffractaic acid as the major secondary metabolite, namely *X. tucsonensis*, *X. everardensis*, and *X. mannumensis*. However, the latter two species are distinguished clearly by the black lower surface, in contrast to the tan to brown lower cortex of *X. tucsonensis*.

Morphologically, *X. tucsonensis* resembles *X. barbatica* and related species of the *Xanthoparmelia lineola* group. A key to these species is given under *X. lineola*. The close relationship between *X. barbatica* and *X. tucsonensis* is discussed under the former.

In the study area *X. tucsonensis* is restricted to central Australia, where it is rare on rock ledges with a southerly aspect. It grows with *Acarospora schleicheri* (Ach.) Massal., *Xanthoparmelia cravenii, X. centralis, X. isidiosa, X. scabrosa,* and *X. weberi.*

109. Xanthoparmelia ustulata (Kurok. & Filson) Elix & Jen Johnston, **comb. nov.**

Basionym: *Parmelia ustulata* Kurok. & Filson in *Bull. natn. Sci. Mus. Tokyo* B, **1**: 46 (1975). Type: Australia, South Australia, Cape Catastrophe, Eyre Peninsula, Memory Cove, on rock, *R. Filson* 11834 (MEL 1011807! – holotype).

Illustration: Kurokawa & Filson (op. cit.).

Description. *Thallus* foliose, moderately to tightly adnate, yellow-green to olive-green, darkening in older lobes, subirregularly lobate, *c.* 7 cm diam.; *lobes* imbricate or not, irregular to sublinear-elongate, 1·0–2·5(–4·0) mm wide, ± with imbricate, narrower (0·5–1·0 mm) secondary lobes. *Upper surface* opaque but shiny near apices, emaculate, often with a black margin, older lobes becoming irregularly cracked, lacking soredia and isidia; medulla white; *lower* *surface* pale brown, but often darker towards lobe apices, sparsely rhizinate, rhizines simple, slender, short (0·2 mm), concolorous with lower surface. *Apothecia* adnate, 1·5–7·0 mm diam., concave at first but becoming flattened or irregular and crenulate with age, disc dark brown, margin entire, thin, exciple smooth; spores 8–10 × 5–6 μm.

CHEMISTRY. Thallus K−; medulla K−, C−, KC−, P−; containing usnic acid, constipatic acid, protoconstipatic acid (±), dehydroconstipatic acid (±), pertusaric acid (±), unknown aliphatic acids (±).

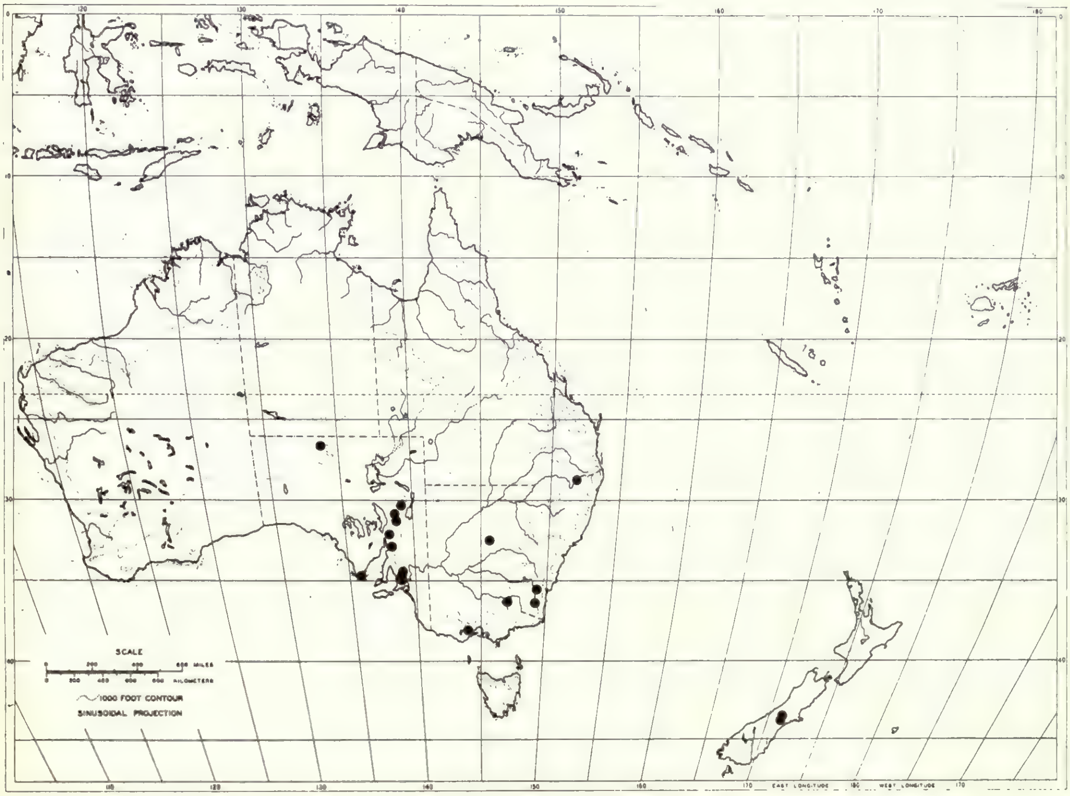
DISTRIBUTION. Southern and eastern Australia (Qld, NSW, ACT, Vic, SA) and South Island, New Zealand (Mackenzie Country). Map 109. On rocks in coastal, drier mountain, subalpine, and subarid areas. Specimens examined: 39.

NOTES. This species is characterised by the moderately to tightly adnate thallus, the broad lobes, the pale lower surface, and the production of aliphatic acids in the medulla.

The moderately adnate specimens resemble *X. bungendorensis* and *X. elixii* with adnate lobes, a pale lower surface, and moderate to sparse rhizines. However, *X. ustulata* tends to be more tightly adnate than the other two species and does not develop the thick, imbricate mat of lobes commonly observed in *X. elixii*. Furthermore, these species differ chemically; *X. elixii* contains norstictic and (±) salazinic acids, *X. bungendorensis* the scabrosin metabolites, and *X. ustulata* the aliphatic acids, constipatic acid and protoconstipatic acid, in addition to usnic acid.

The more tightly adnate specimens of *X. ustulata* resemble *X. lineola* and other members of this group of species. A key to these species is given under *X. lineola*, but their distinction relies heavily on chemical characters.

Chemically, *X. ustulata* is similar or identical to *X. oleosa*, but the latter species is more diminutive (lobes 0·8–1·5 mm wide), flat and becomes areolate and subcrustose centrally. In



Map 109 Distribution of *Xanthoparmelia ustulata* in Australia and New Zealand.

contrast the thallus of *X. ustulata* is distinctly foliose with broader (1·0–4·0 mm), subrotund lobes, which are ± subascending at the apices.

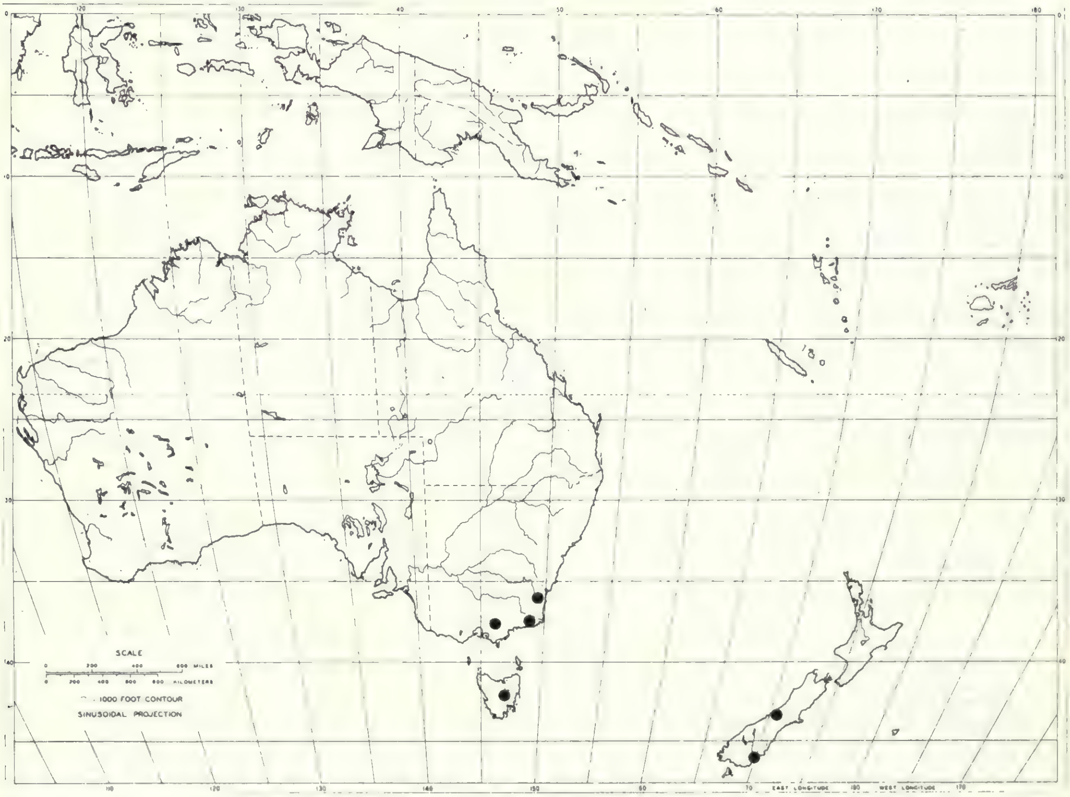
X. ustulata closely resembles in both morphology and chemistry *X. subdecipiens* (Vainio) Hale, occurring in South Africa and North America. However, *X. ustulata* is usually more loosely adnate, with narrower (1·0–2·5 mm) lobes, which are commonly subascending at the apices, while the broader (2·0–5·0 mm) lobes of *X. subdecipiens* are rotund and tightly adnate to the apices. Although both species contain a number of aliphatic acids (in fact overlapping chemosyndromes), the major aliphatic acids (of unknown structure) present in *X. subdecipiens* are absent from *X. ustulata* (Table 5).

Table 5 Aliphatic acids present in *X. subdecipiens* and *X. ustulata*.

Acid (R_f in solvent C)	*X. subdecipiens*	*X. ustulata*
Unknown, (38)	trace	
Unknown, (37)	major	
Dehydroconstipatic, (36)	minor	trace
Unknown, (35)	major	
Pertusaric, (32)	minor	trace
Constipatic, (28)	trace	major
Protoconstipatic, (26)	minor	major

X. ustulata is scattered in south-eastern Australia and South Island, New Zealand, where it is often found growing together with *X. metaclystoides, X. neotinctina, X. scabrosa, X. substrigosa,* and *X. elixii*.

110. Xanthoparmelia verdonii Elix & Jen Johnston, sp. nov.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Map 110 Distribution of *Xanthoparmelia verdonii* in Australia and New Zealand.

Thallus ut in *Xanthoparmelia scabrosa* sed superficie inferior nigro differt. Superficies superior isidiata, isidiis globosis demum ad apices inflatos, apicibus saepe erumpentibus. Thallus 190–230 μm crassus; cortex superior 14–21 μm crassus, stratum gonidiale 10–18 μm crassum, medulla 140–160 μm crassa, cortex inferior 10–18 μm crassus. Thallus K−; medulla K−, C−, KC+ roseus, P−; acidum usnicum et loxodinum et norlobaridonum continens.

Type: Australia, Victoria, Alfred National Park, 19 km east of Cann River township, on granite rocks along the roadside, 350 m, 21 November 1978, *J. A. Elix* 5252 & *D. Verdon* (CBG! – holotype).
Illustration: Fig. 37.

DESCRIPTION. *Thallus* foliose, adnate to the substrate, yellow-green, often blackened towards centre, 5–7 cm diam.; *lobes* irregular, sublinear-elongate, imbricate or not, 1·0–3·0 mm wide, margin commonly blackened. *Upper surface* emaculate, coriaceous, conspicuously wrinkled and irregularly cracked in older parts, isidiate; *isidia* warty to subglobose at first, but sometimes becoming gnarled-branched, inflated at apices with apices breaking open, becoming granular but not truly sorediose; medulla white. *Lower surface* black for the most part, elsewhere brown-black, shiny, moderately rhizinate, rhizines simple, black. *Apothecia* not seen.

CHEMISTRY. Thallus K−; medulla K−, C−, KC+ rose, P−; containing usnic acid, loxodin, norlobaridone.

DISTRIBUTION. Rare in southern NSW, Vic, Tas, and South Island, New Zealand. Map 110. On rocks in moist forests. Specimens examined: 7.

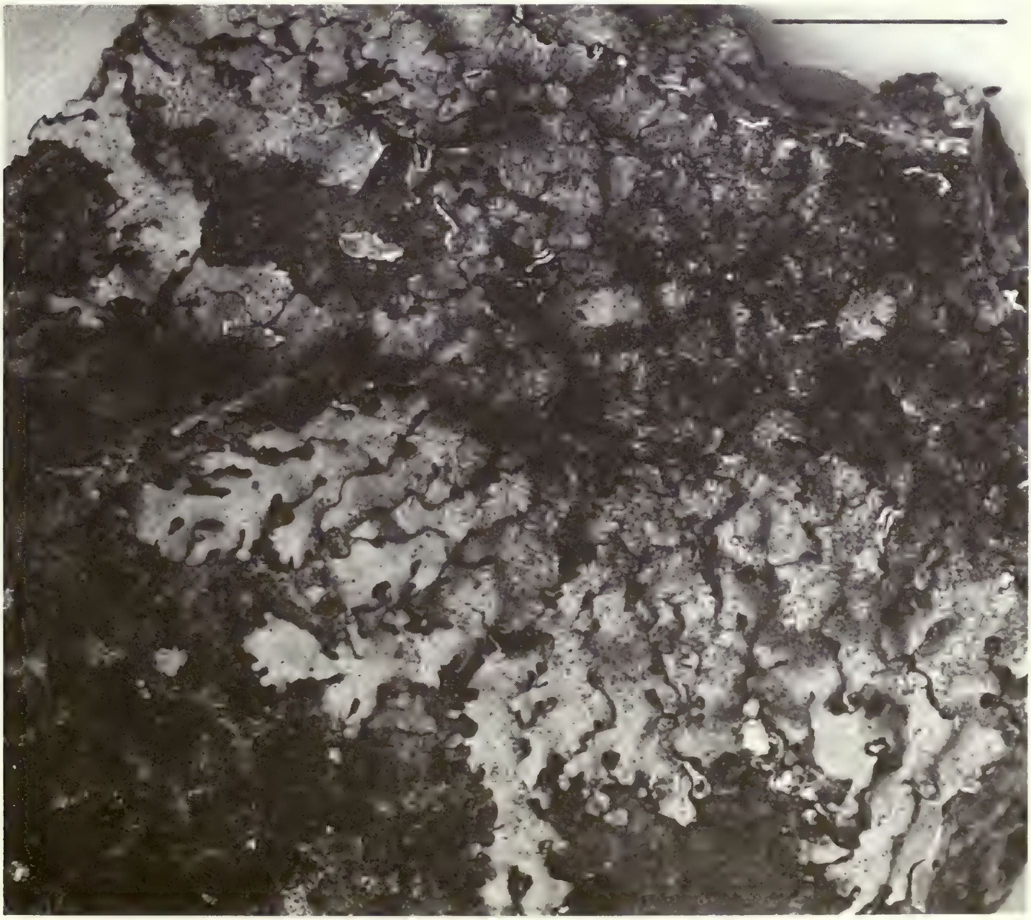


Fig. 37 *Xanthoparmelia verdonii* Elix & Jen Johnston. Holotype in CBG. Scale = 1 cm.

NOTES. The presence of erumpent, warty isidia and the production of loxodin and norlobaridone in this species are reminiscent of *Xanthoparmelia scabrosa*, one of the most common isidiate species in Australasia. However *X. scabrosa* is more loosely adnate than *X. verdonii*, and has a pale tan to brown lower surface, while in *X. verdonii* the lower surface is black. It would appear that *X. verdonii* is closely reated to *X. thamnoides* because both species are isidiate, have similar coriaceous thalli, a black lower surface, and identical medullary chemistry. These species differ in the nature of the isidia: *X. thamnoides* has slender, cylindrical isidia which become coralloid-branched, while *X. verdonii* has squat, warty isidia which become erumpent and gnarled-branched.

This species is named in honour of the Australian botanist and lichenologist, Doug Verdon, of Canberra.

X. verdonii is a rare species, scattered in south-eastern Australia and New Zealand. It prefers moist habitats and may be found growing in association with *Parmelia signifera* Nyl., *Cladia aggregata* (Swartz) Nyl., *Xanthoparmelia amplexula, X. flavescentireagens,* and *X. tasmanica*.

111. **Xanthoparmelia verruciformis** Elix & Jen Johnston, **sp. nov.**

Thallus ut in *Xanthoparmelia pertinaci* sed acidum protocetraricum continenti differt. Thallus 190–250 μm crassus; cortex superior 20–35 μm crassus, stratum gonidiale 35–80 μm crassum, medulla 70–110 μm crassa, cortex inferior 10–14 μm crassus. Thallus K−; medulla K+ brunnescens, C−, P+ aurantiaco-rubescens.

Type: Australia, South Australia, Flinders Ranges, Bolla Bollana copper smelter, 7·5 km north-west of Arkaroola, on rocks in open, stunted *Acacia* woodland, 30°18′S, 139°21′E, 400 m, 31 October 1984, *J. A. Elix* 18080b & *L. H. Elix* (CBG! – holotype).

Illustration: Fig. 38.

DESCRIPTION. *Thallus* foliose to subcrustose, tightly adnate on rocks, yellow-green, darkening with age and becoming dark greyish-green, *c.* 5 cm diam.; *lobes* sublinear-elongate to subirregular, imbricate or not, older lobes extensively fractured and verruciform areolae commonly formed, lobes 1·0–2·5(–3·0) mm wide and areolae *c.* 1·0 mm diam. *Upper surface* opaque, emaculate, often tangentially cracked, becoming rugulose and areolate, commonly black-margined, particularly towards lobe apices, lacking soredia and isidia but with numerous, black, recessed pycnidia; medulla white. *Lower surface* pale tan to light brown, often somewhat darker

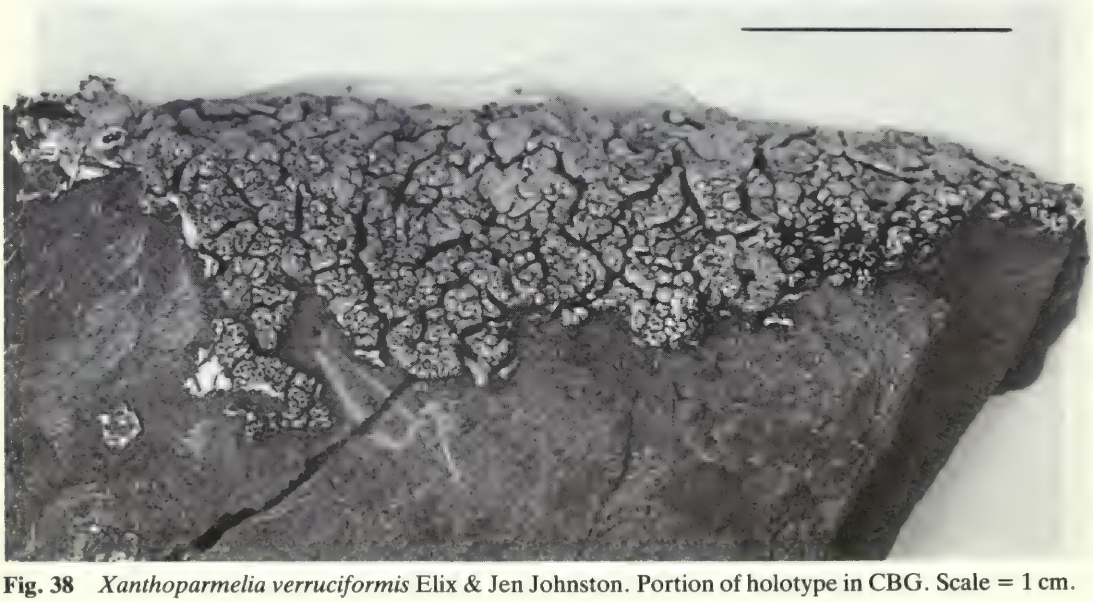


Fig. 38 *Xanthoparmelia verruciformis* Elix & Jen Johnston. Portion of holotype in CBG. Scale = 1 cm.

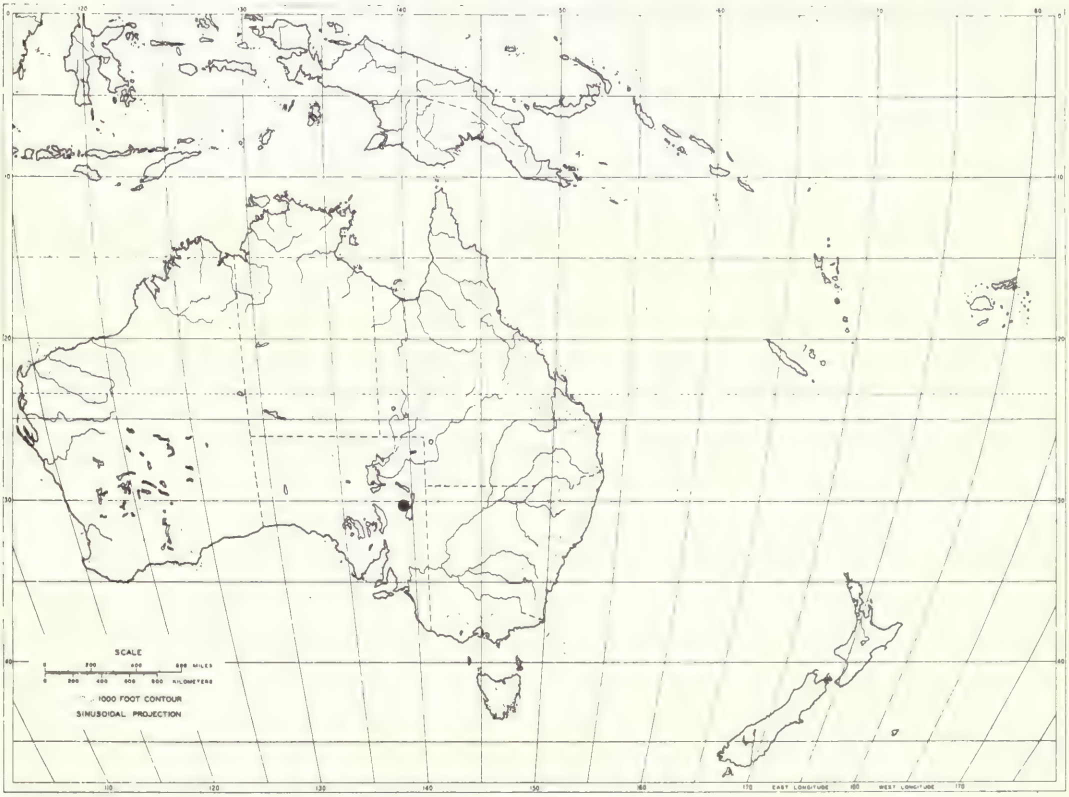
to smoke-grey near lobe apices, moderately rhizinate, rhizines pale brown, short, slender, simple. *Apothecia* not seen.

Chemistry. Thallus K−; medulla K+, yellow-brown, C−, P+ orange-red; containing usnic acid, protocetraric acid.

Distribution. Flinders Ranges (SA). Map 111. On rocks in arid area. Specimens examined: 1.

Notes. This species closely resembles *Xanthoparmelia pertinax* and *X. cravenii* in morphology, the thalli being characteristically tightly adnate, with narrow, sublinear-elongate lobes, which often develop wart-like areolae in the older parts, and have a pale brown lower surface. However, *X. verruciformis* is quite distinct chemically since it produces usnic acid and protocetraric acid rather than the scabrosin derivatives of *X. cravenii*, or fumarprotocetraric acid and succinprotocetraric acid as in *X. pertinax*. *X. verruciformis* and *X. pertinax* could be considered chemical strains of the one species, but since they appear to maintain their chemical integrity when sympatric, we have considered them distinct taxa at the species level. Both species belong to the *X. lineola* group, with a key being given under that species.

X. verruciformis is a very rare species from the Flinders Ranges of South Australia, where it grows with *X. amplexula, X. cravenii, X. lineola, X. metaclystoides,* and *X. pertinax*.



Map 111 Distribution of *Xanthoparmelia verruciformis* in Australia.

112. **Xanthoparmelia versicolor** Hale

in *Phytologia* **28**: 490 (1974) (Art. 72 note 1).

≡ *Parmelia versicolor* Müll. Arg. in *Flora, Jena* **64**: 506 (1881), non *Parmelia versicolor* (Pers.) Ach., *Meth. Lich.*: 190 (1803) (Art. 64.1). Type: Australia, Nova Hollandia, Eurio, ad terram sabulosam, June 1880, *A. Richards* (G! – holotype).

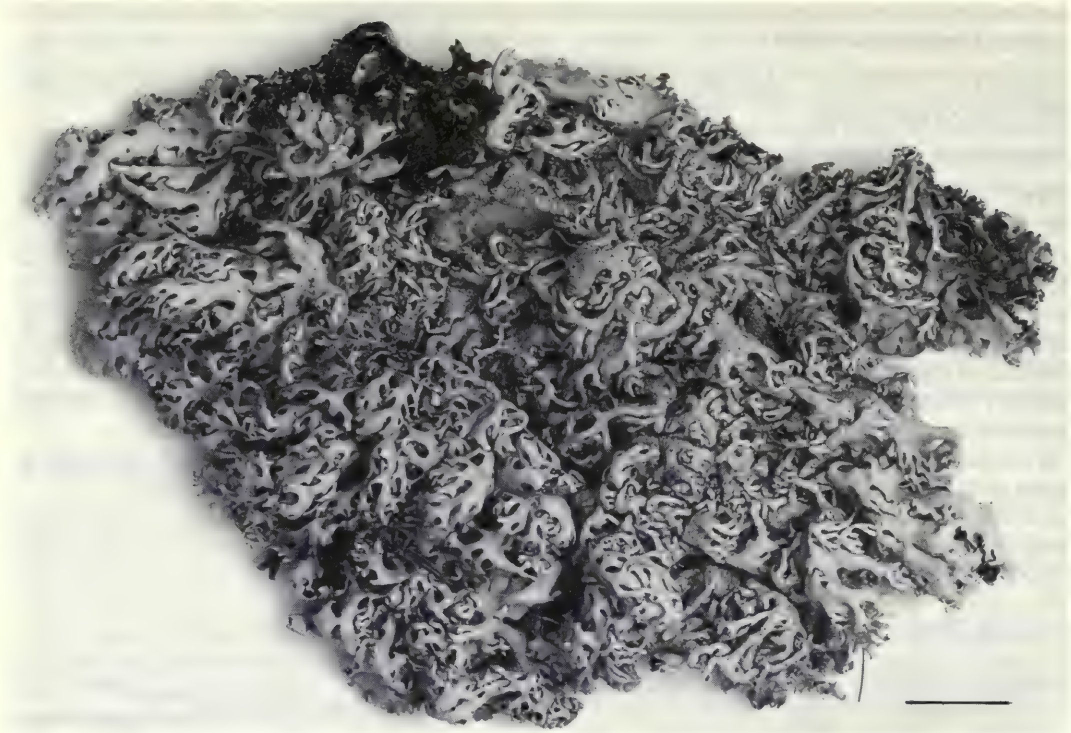


Fig. 39 *Xanthoparmelia versicolor* Hale. *Day* in ANUC. Scale = 1 cm.

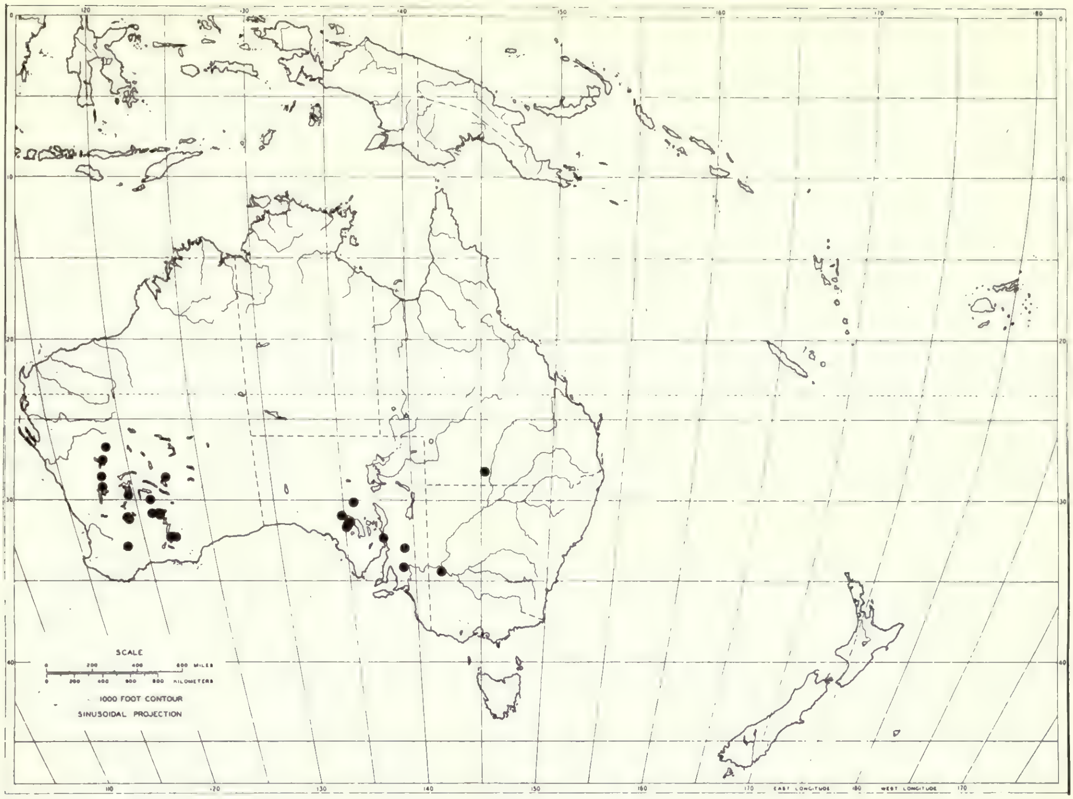
≡ *Parmelia callifolia* Kurok. in Kurokawa & Filson in *Bull. natn. Sci. Mus. Tokyo* B, **1**: 42 (1975).
Illustration: Fig. 39.

DESCRIPTION. *Thallus* foliose, loosely adnate on soils or rarely on rocks, pale yellow-green, to 15 cm diam., often growing over debris; *lobes* at margin 1·5–3·0 mm wide, free, imbricate, apices crenulate; secondary lobes growing out from lobules at margins of older lobes, to 1·5 mm wide, irregularly branched, flat to convolute. *Upper surface* smooth at margins, older portions becoming rugulose and cracked, convex, opaque, sometimes slightly maculate, (±) pruinose near apices, lacking soredia and isidia; medulla white. *Lower surface* black to brown-black but brown in a broad zone near the apices, moderately to densely rhizinate, rhizines simple, concolorous with the lower surface. *Apothecia* very rare, sessile, to 4 mm diam., concave, disc black-brown, margin thick, involute, undulate, exciple smooth; spores 7–9 × 4–6·5 μm.

CHEMISTRY. Thallus K−; medulla K+ yellow becoming dark red, C−, KC−, P+ yellow becoming orange; containing usnic acid, salazinic acid, and (±) consalazinic acid.

DISTRIBUTION. Drier areas of SA, WA, Qld, and Vic. Map 112. On soils in shrublands of subarid and arid zones. Specimens examined: 59.

NOTES. This lichen is a dry soil-inhabiting species, in sheltered positions under bushes where it grows amongst litter. It is characterised by the markedly convex lobes and the revolute secondary lobes growing out from lobules on the margins of older lobes in the centre of the thallus. Six other species show a similar combination of characters, namely *X. alternata, X. eilifii, X. molliuscula, X. norpumila, X. pumila*, and *X. terrestris*; but *X. molliuscula, X. terrestris, X. eilifii*, and *X. alternata* are readily differentiated by the paler lower surface. *X. versicolor* and *X. pumila* both have a dark brown to black lower surface and both produce salazinic acid. However *X. pumila* is distinguished by its more adnate thalli, narrower lobes, and a submarginal pruinose zone on the upper surface. Further, while *X. versicolor* produces



Map 112 Distribution of *Xanthoparmelia versicolor* in Australia.

revolute to convolute secondary lobes to 1·5 mm wide, the other three species commonly produce subterete lobules, *c.* 0·5 mm wide. *X. norpumila* is morphologically similar to *X. pumila* but contains norstictic and connorstictic acids in the medulla.

X. versicolor might also be confused with *X. subdistorta* since both are terricolous with revolute lobes. However the lobes of *X. subdistorta* are narrow and dichotomously divided and this species lacks lobules. By contrast *X. versicolor* has broad irregular lobes and is lobulate. These species also differ chemically as *X. subdistorta* produces loxodin and norlobaridone.

Common terricolous associates of *X. versicolor* include *X. terrestris, X. amphixantha, Chondropsis semiviridis* (Nyl.) Nyl., and *Psora decipiens* (Hedwig) Hoffm.

Key to the *Xanthoparmelia versicolor* group in Australasia

Lobes convex, lobulate in the centre, non-isidiate, terricolous.

1a. Lower surface pale tan to brown 2
1b. Lower surface dark brown to black 6

2a(1a). Medulla K−, KC+ rose (loxodin, norlobaridone) .... **33. X. eilifii** (p. 235)
2b. Medulla K+ yellow or yellow-red 3

3a(2b). Medulla K+ yellow (stictic acid – major) .... **69. X. molliuscula** (p. 289)
3b. Medulla K+ yellow-reddish 4

4a(3b). Medulla K+ yellow-pale red (hypostictic, hyposalazinic acids) .... **102. X. sulcifera** (p. 335)
4b. Medulla K+ yellow-deep red 5

5a(4b). Thallus forming subpulvinate clumps (norstictic acid – major) .... **106. X. terrestris** (p. 341)
5b. Thallus more or less flat on soil (salazinic acid – major) .... **3. X. alternata** (p. 188)

6a(1b). Lower surface dark brown (loxodin, norlobaridone) 7

6b. Lower surface black, lacking loxodin, norlobaridone 8

7a(6a). Lobes 1·0–2·5 mm wide, generally lobulate, mildly convex .... **33. X. eilifii** (p. 235)
7b. Lobes 0·3–1·0 mm wide, elobulate, markedly convex .... **96. X. subdistorta** (p. 326)

8a(6b). Thallus loosely adnate, lobes 1–3 mm wide, lobulae flat or revolute (salazinic acid) **112. X. versicolor** (p. 349)
8b. Thallus adnate, lobes 0·8–1·5 mm wide, lobules subterete 9

9a(8b). Medulla containing salazinic acid (major) .... **86. X. pumila** (p. 312)
9b. Medulla containing norstictic acid (major) .... **77. X. norpumila** (p. 300)

113. Xanthoparmelia vicaria Elix & Jen Johnston, **sp. nov.**

Thallus ut in *Xanthoparmelia neotinctina* sed acidum barbaticum et acidum 4-*0*-demethylbarbaticum et acidum 3-α-hydroxybarbaticum continenti differt. Superficies superior isidiata, isidiis cylindricis, dense ramosis. Superficies inferior nigra, modice rhizinata, rhizinis simplicibus vel parce ramosis, concoloribus. Thallus 105–160 μm crassus; cortex superior 14–20 μm crassus, stratum gonidiale 10–15 μm crassum, medulla 60–110 μm crassa, cortex inferior 10–14 μm crassus. Thallus K−; medulla K−, C−, KC+ flavens, P−.

Type: Australia, Tasmania, Gunners Quoin, 42°46′S 147°19′E, *M. A. Cutliffe* (G. C. Bratt 73/553) (HO 42734! – holotype).
Illustration: Fig. 40.

Description. *Thallus* foliose, adnate to rocks, yellow-green, darkening with age, 3–4 cm diam.; *lobes* irregular, imbricate, 1·0–2·0(–3·0) mm wide, occasionally with narrower secondary lobes overlaying centre of thallus. *Upper surface* rugulose, shiny near apices, emaculate, flat to slightly concave, margins often blackened, particularly towards apices, without soredia but densely isidiate, *isidia* cylindrical, simple then coralloid-branched, forming a dense mat at centre; medulla white. *Lower surface* black, subshiny, rugulose, brown at apices, moderately rhizinate, rhizines slender, simple or occasionally tufted and branched, black. *Apothecia* not seen.

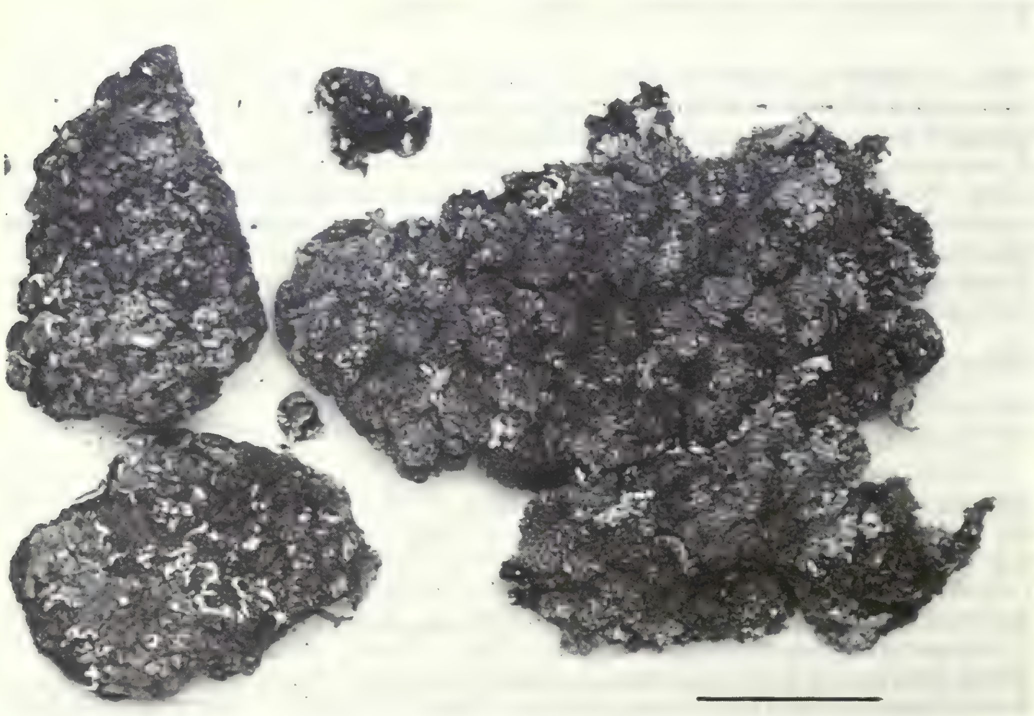
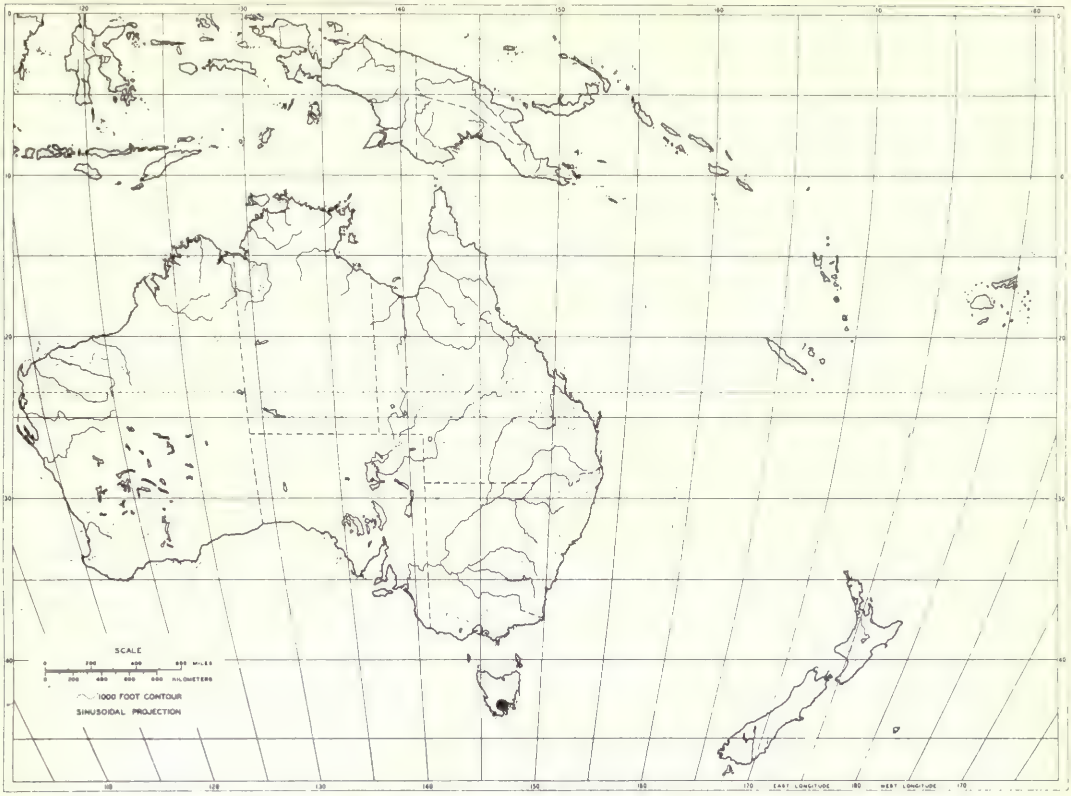


Fig. 40 *Xanthoparmelia vicaria* Elix & Jen Johnston. Holotype in HO. Scale = 1 cm.



Map 113 Distribution of *Xanthoparmelia vicaria* in Australia.

CHEMISTRY. Thallus K−; medulla K−, C−, KC+ yellow, P−; containing usnic acid, barbatic acid, 4-*0*-demethylbarbatic acid, and traces of 3-α-hydroxybarbatic acid.

DISTRIBUTION. Tasmania. Map 113. On alpine rocks. Specimens examined: 1.

NOTES. This species resembles *Xanthoparmelia neotinctina* in morphology, since both species have narrow lobes with a black lower surface and develop cylindrical isidia on the upper surface which become densely coralloid-branched with age. However, *X. neotinctina* generally is distinct chemically since it contains usnic, norstictic, and salazinic acids (K+ yellow-red), rather than the usnic and barbatic acids (K−, KC+ yellow) present in *X. vicaria*.

Table 6 Depsides present in *X. nashii* and *X. vicaria*.

Depside	*X. nashii*	*X. vicaria*
Barbatic acid	minor	major
4-*0*-Demethylbarbatic acid	trace	major
Diffractaic acid	major	—
3-α-Hydroxybarbatic acid	trace	trace

Chemically and morphologically *X. vicaria* resembles *X. nashii*, since these species exhibit overlapping chemosyndromes (Table 6), have a black lower surface, and develop cylindrical isidia. However the isidia are densely coralloid-branched in *X. vicaria*, but are simple and sparingly branched in *X. nashii*. Furthermore, the lobes are linear-elongate in the latter species but irregular in *X. vicaria*.

X. vicaria is a very rare species and at present is known only from the type locality.

114. **Xanthoparmelia weberi** (Hale) Hale

in *Phytologia* **28**: 490 (1974).

≡ *Parmelia weberi* Hale in *Phytologia* **22**: 92 (1971). Type: U.S.A., Arizona, Pinal Co., Desert Mtns, 5 km SW. Superior, just south of Picketpost Mountain, near Southwest Arboretum, 2 January 1953, 840 m., *W. A. Weber & J. B. McCleary* S1897 (COLO – holotype, US – isotype).

Illustration: Fig. 41.

DESCRIPTION. *Thallus* foliose, moderately to tightly adnate on rocks, yellow-green, 3–5(–7) cm diam.; *lobes* irregular, imbricate or not, 0·8–2·0(–3·0 mm wide, apices generally crenate or shallowly notched. *Upper surface* shiny, at least at the margin, emaculate or here and there indistinctly maculate, isidiate, *isidia* laminal, globose to short cylindrical, simple at first, becoming dense, short-coralloid, expanding laterally but sparingly branched, ultimately apices becoming inflated and ± erumpent, not at all sorediose. *Lower surface* pale tan to light brown, darker at apices, shiny, moderately to sparsely rhizinate, rhizines simple, slender, ± elongated to 0·8 mm long, concolorous with lower surface. *Apothecia* not seen.

CHEMISTRY. Thallus K−; medulla K−, C−, KC−, P−; containing usnic acid, hypoprotocetraric acid, constipatic acid (±), protoconstipatic acid (±), scabrosin 4,4′-diacetate (±), scabrosin

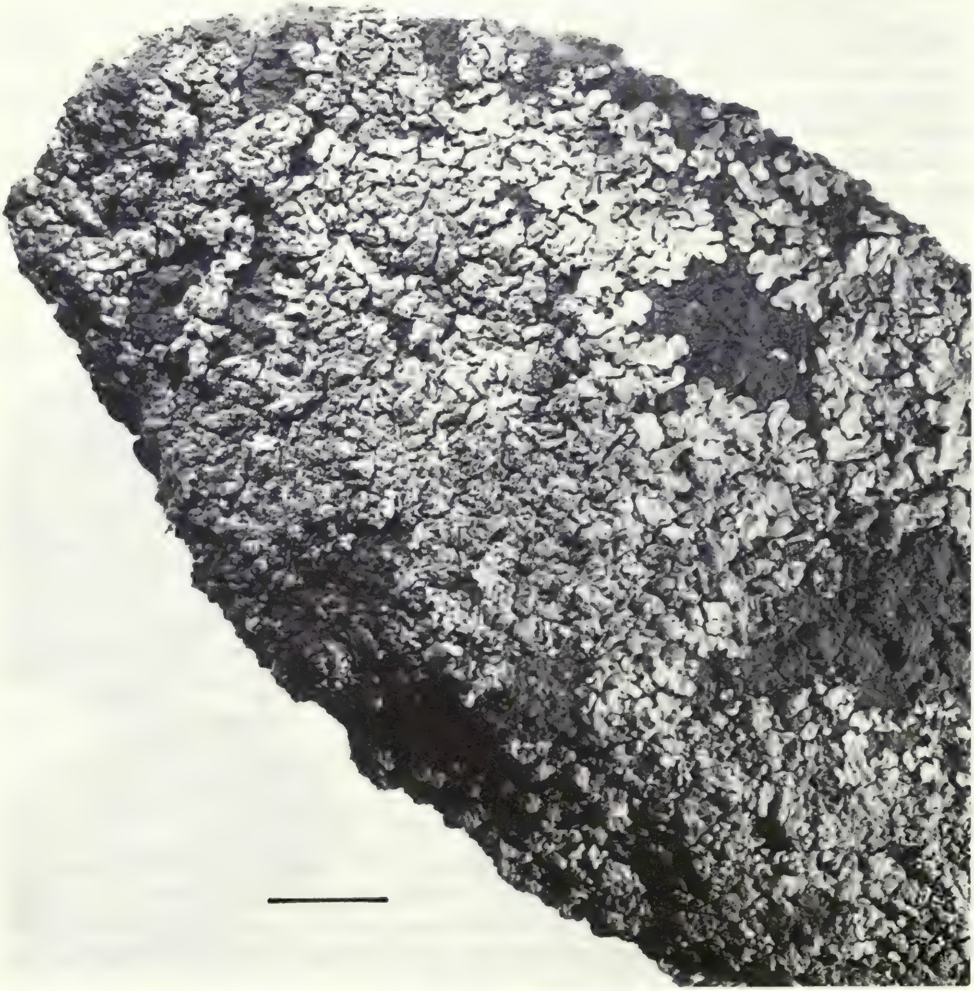
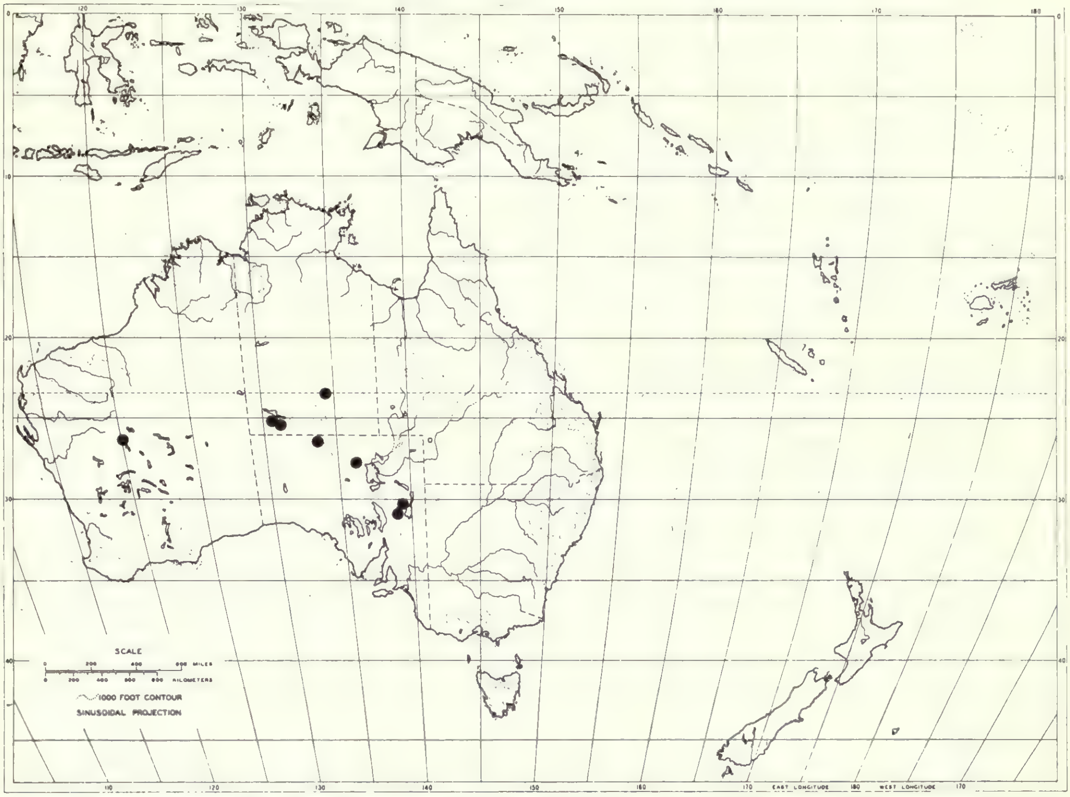


Fig. 41 *Xanthoparmelia weberi* (Hale) Hale. *Elix* 11071 in ANUC. Scale = 1 cm.

4-acetate-4′-butyrate (±), scabrosin 4-acetate-4′-hexanoate (±), scabrosin 4,4′-dibutyrate (±), unknowns (traces ±).

DISTRIBUTION. Rare in northern SA, inland WA, and central Australia (NT). Map 114. Also known from south-western U.S.A. (Arizona, New Mexico), Mexico, Kenya, Uganda, and South Africa. On rocks with a southerly aspect in arid areas. Specimens examined: 14.



Map 114 Distribution of *Xanthoparmelia weberi* in Australia.

NOTES. Morphologically this species resembles *Xanthoparmelia centralis, X. flindersiana,* and *X. praegnans* because all four species have tightly adnate thalli, a pale brown lower surface, and produce inflated, ± erumpent isidia. Whereas *X. weberi* and *X. flindersiana* have broad lobes (1·0–3·0 mm) and are distinctly foliose, *X. centralis* and *X. praegnans* have narrow lobes (0·5–1·5 mm) and the thalli of *X. praegnans* often become subcrustose towards the centre. Although *X. weberi* is usually more loosely adnate and more densely isidiate than *X. flindersiana*, these species can be distinguished most reliably chemically, since *X. flindersiana* reacts K+ yellow-red (norstictic acid) and *X. weberi* reacts K− (hypoprotocetraric acid).

X. weberi is a rare species in Australia, known only from the far north of South Australia, inland Western Australia, and the MacDonnell Ranges of central Australia. In these areas it grows on rocks with a southerly aspect, together with *X. cravenii, X. consociata, X. mexicana, X. scabrosa,* and *X. subdomokosii*.

115. Xanthoparmelia willisii (Kurok. & Filson) Elix & Jen Johnston, comb. nov.

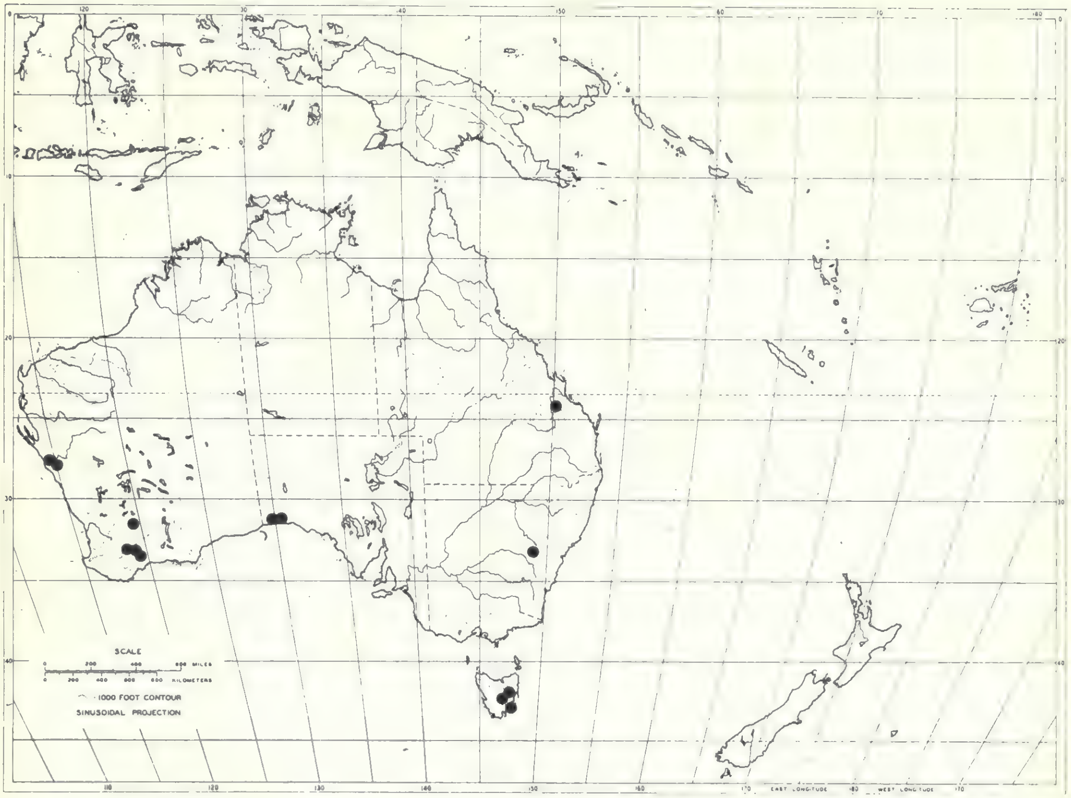
Basionym: *Parmelia willisii* Kurok. & Filson in Filson in *Aust. J. Bot.* **30**: 577 (1982). Type: Australia, South Australia, Nullarbor Region, Eyre Highway, 18 km east of Koonalda, 18 October 1961, *J. H. Willis* (MEL 17651! – holotype).

Illustration: Filson (op. cit.).

Description. *Thallus* foliose, subpulvinate, unattached on soils, pale yellow to pale yellow-green, forming irregular rosettes or cushions, 1–3 cm diam.; *lobes* sublinear-elongate, subdichotomously to irregularly branched, often distorted and twisted, exposing the lower surface, 1·0–2·5 mm wide. *Upper surface* plane to slightly convex, smooth or slightly rugulose in older lobes, maculate, lacking soredia and isidia; medulla white. *Lower surface* plane to canaliculate, concolorous with the upper surface, very sparsely rhizinate, rhizines black, simple or rarely sparsely branched, 1–3 mm long. *Apothecia* not seen.

Chemistry. Thallus K−; medulla K+ faint gold, C−, KC−, P+ yellow then red; containing usnic acid, fumarprotocetraric acid, succinprotocetraric acid, trace protocetraric acid (±), trace physodalic acid (±).

Distribution. Australia (Qld, NSW, SA, WA, Tas). Map 115. On soil in drier upland, subarid and arid areas. Specimens examined: 25.



Map 115 Distribution of *Xanthoparmelia willisii* in Australia.

Notes. *Xanthoparmelia willisii* belongs to the *X. amphixantha* group, which is characterised by thalli forming small rosettes on soil and lobes with a canaliculate undersurface. *X. willisii* has the same chemistry as *X. reptans*, another member of this group, but the latter species has regularly dichotomously branched lobes which are moderately rhizinate, the lower surface is usually brown, and the thallus lies flat on the soil. *X. willisii* on the other hand is commonly subpulvinate, forming subfruticose cushions on soils, is very sparsely rhizinate, and the lower surface is concolorous with the upper. Even so, in several localities these two species are occasionally difficult to distinguish. For further discussion and a key to this group of species refer to *X. amphixantha*.

X. willisii is scattered in the drier areas of southern Australia, where it is often found together with *Chondropsis semiviridis* (Nyl.) Nyl., and other terricolous lichens including *Psora decipiens* (Hedwig) Hoffm., *Diploschistes scruposus* (Schreber) Norman, *Xanthoparmelia convoluta, X. versicolor, X. reptans,* and *X. sulcifera.*

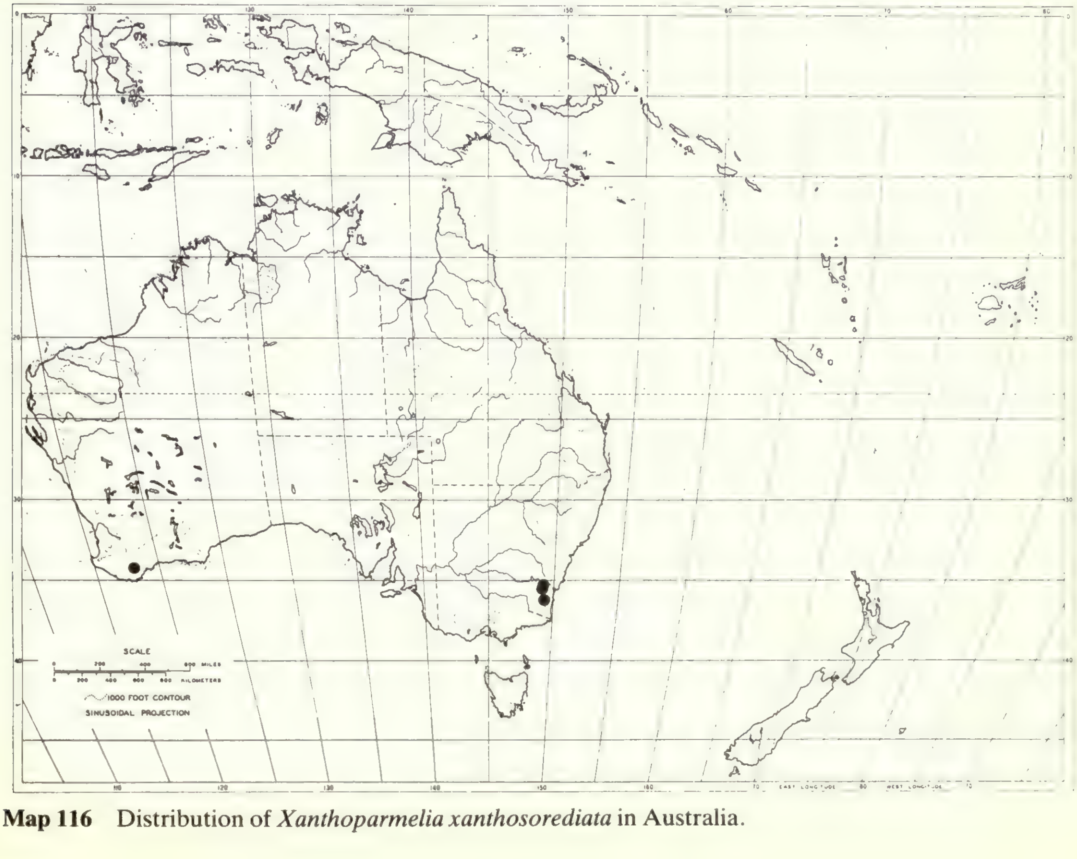
116. **Xanthoparmelia xanthosorediata** (Elix) Elix & Jen Johnston, **comb. nov.**

Basionym: *Parmelia xanthosorediata* Elix in *Aust. J. Bot.* **29**: 373 (1981). Type: Australia, Australian Capital Territory, Kowen Forest, 16 km east of Canberra, on sandstone rocks, 730 m, *J. A. Elix* 1830 (MEL! – holotype; CBG! – isotype).
Illustration: Elix (op. cit.).

DESCRIPTION. *Thallus* small foliose, adnate to tightly adnate on rocks, yellowish green, subirregularly lobate, 3–5 cm diam.; *lobes* sublinear to subirregular, 0·5–2·0 mm wide. *Upper surface* shiny, emaculate, often black-margined, plane for the most part but developing transverse cracks with age, becoming rugose and areolate, densely sorediate, the *soralia* globose-capitate at first then coalescing, soredia granular; medulla white. *Lower surface* chestnut brown except for a black-brown marginal zone which is particularly prominent near the lobe apices, moderately rhizinate, rhizines simple, concolorous with the lower surface. *Apothecia* rare, adnate, 1–3 mm diam., disc red-brown; spores 5–8 × 4–6 μm.

CHEMISTRY. Thallus K−; medulla K−, C−, KC+ rose, P−. Thallus containing usnic acid, constipatic acid, protoconstipatic acid, loxodin, conloxodin, norlobaridone, conorlobaridone, and an unknown substance.

DISTRIBUTION. Southern Australia (southern tablelands of NSW, ACT, Stirling Ranges of WA). Map 116. On rocks in dry upland areas. Specimens examined: 8.



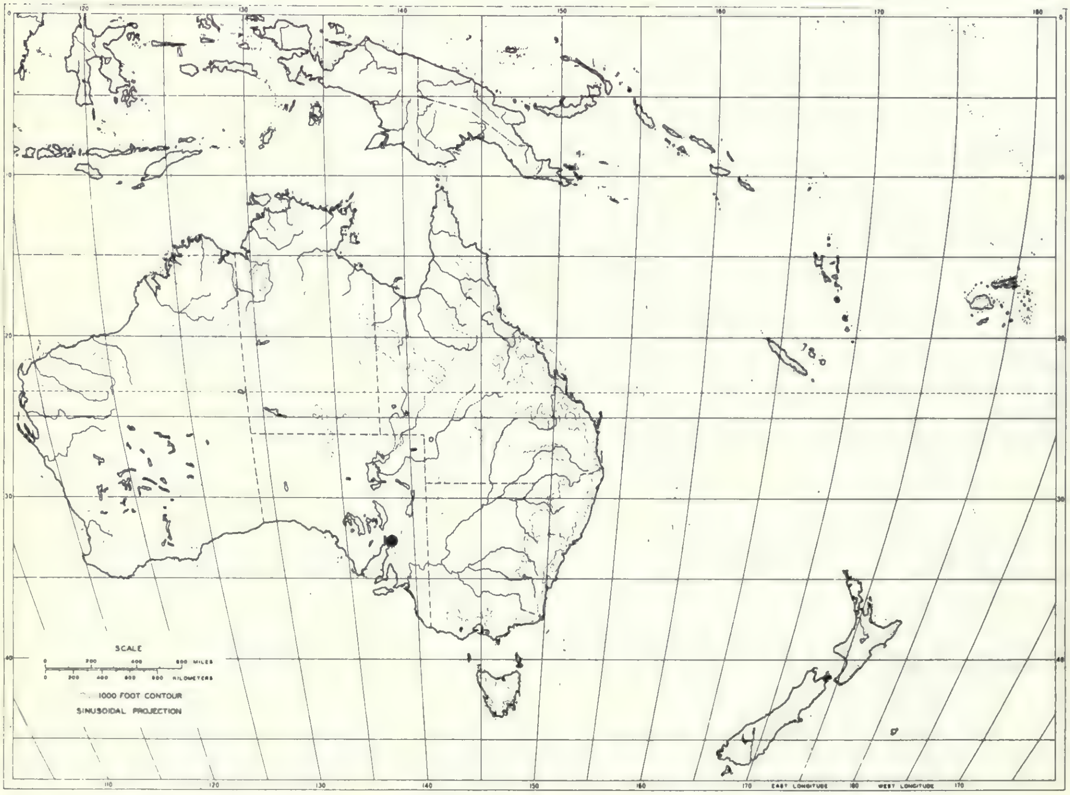
Map 116 Distribution of *Xanthoparmelia xanthosorediata* in Australia.

NOTES. At present, this distinctive species is one of only four Australian species of *Xanthoparmelia* known to produce soredia. Both the morphological features and the chemistry are highly characteristic. In addition to usnic acid, constipatic acid, protoconstipatic acid, loxodin, and norlobaridone which are reasonably common in Australian species of the genus, this lichen produces conloxodin and conorlobaridone (Begg, Chester & Elix, 1979; Chester & Elix, 1979*b*). According to the theories of progressive chemical evolution towards shorter side chains in phenolic metabolites (Culberson & Culberson, 1977) and morphological evolution towards asexual propagation of lichens (Poelt 1970, 1972), it would appear that *X. xanthosorediata* is an evolutionarily advanced species. This is indicated by the presence of soredia and the production of conloxodin and conorlobaridone (since these despsidones have a 3 carbon side chain in ring-B rather than the 5-carbon chain of loxodin and norlobaridone). The other sorediate species differ in having highly convoluted or canaliculate lobes, which grow loosely over soil, while *X. xanthosorediata* has plane lobes which are adnate to rocks.

X. xanthosorediata is a rare and scattered species in south-western and south-eastern Australia where it grows in association with *X. australasica, X. filarszkyana, X. scabrosa, X. taractica,* and *X. tasmanica.*

117. Xanthoparmelia xerophila Elix & Jen Johnston, sp. nov.

Thallus ut in *Xanthoparmelia mougeotina* sed lobis contiguo et acidum barbaticum et acidum 4-*O*-demethylbarbaticum continenti differt. Thallus arcte adpressus, versus centrum fere subcrustosus, isidiata, superfice inferiore nigrescens. Thallus 70–105 μm crassus; cortex superior 10–14 μm crassus, stratum gonidiale 7–14 μm crassum, medulla 40–60 μm crassa, cortex inferior 7–14 μm crassus. Thallus K−; medulla K−, C−, KC+ lutescens, P−.



Map 117 Distribution of *Xanthoparmelia xerophila* in Australia.

Type: Australia, South Australia, Flinders Ranges, lower slopes of Mt Remarkable, Melrose, on rocks in open *Eucalyptus* woodland, 32°50′S, 138°11′E, 500 m, 26 October 1984, *J. A. Elix* 17752 & *L. H. Elix* (CBG! – holotype).

Illustration: Fig. 42.

Description. *Thallus* small foliose to subcrustose, very tightly adnate to rocks, yellow-green, darkening to deep olive-brown or blackish in older lobes, 1–3 cm diam.; *lobes* contiguous, narrow, 0·2–0·8(–1·0) mm wide, not at all imbricate, becoming cracked and eventually forming areolae in the centre of the thallus. *Upper surface* opaque, emaculate, dull and irregularly cracked centrally, becoming crustose-areolate with age, isidiate, *isidia* simple or sparingly branched, globose then gnarled-cylindrical or inflated, brown-tipped; medulla white. *Lower surface* brown-black to black, brown near apices, moderately rhizinate, rhizines simple, often grouped subapically, black or else lower surface adhering directly to the substrate. *Apothecia* not seen.

Chemistry. Cortex K−; medulla K−, C−, KC+ yellow, P−; containing usnic acid, barbatic acid, 4-*0*-demethylbarbatic acid.

Distribution. Flinders Ranges (SA). Map 117. On rocks in open *Eucalyptus* woodland. Specimens examined: 4.

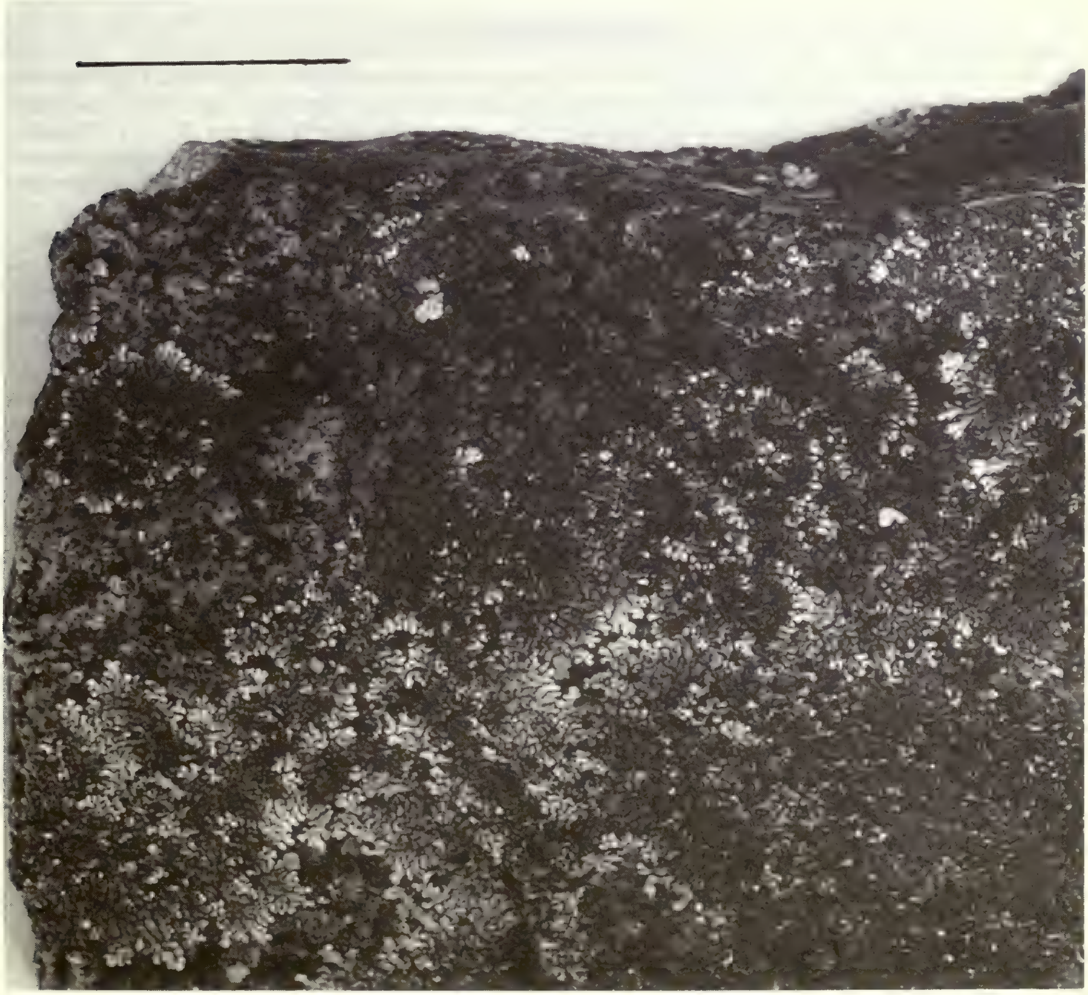


Fig. 42 *Xanthoparmelia xerophila* Elix & Jen Johnston. Holotype in CBG. Scale = 1 cm.

Notes. This species is characterised by a subcrustose thallus, tightly adnate lobes with a black lower surface, the presence of isidia, and the production of barbatic acid and 4-*0*-demethylbarbatic acid in the medulla. This species would appear to be the isidiate counterpart of *X. louisii*.

Morphologically this species closely resembles *X. mougeotina*, but the well-separated, stellate lobes so common in this species have not been observed in *X. xerophila*. The lobes of *X. xerophila* tend to be more or less contiguous throughout, although *X. mougeotina* does exhibit a similar growth form under certain conditions. Furthermore, *X. xerophila* has a very restricted distribution in South Australia, in contrast to the cosmopolitan distribution of *X. mougeotina*. No doubt these taxa could be considered chemical 'species', but as they do show different geographical distributions and contain biosynthetically distant metabolites, we consider them distinct.

Chemically *X. xerophila* is identical with another isidiate Australian species with a black lower surface, *X. vicaria*. However, the latter taxon has moderately adnate, broad lobes (1·0–3·0 mm wide) and a distinctly foliose thallus, so is morphologically quite dissimilar.

X. xerophila is a rarely collected, but possibly overlooked, species from the Flinders Ranges in SA. It occurs on exposed rocks in open eucalypt woodland and was found together with *X. adhaerens, X. filarszkyana, X. metaclystoides, X. exillima,* and *X. tasmanica*.

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